

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Information Technology

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC701	Enterprise Network Design	4	-	-	4	-	-	4
ITC702	Infrastructure Security	4	-	-	4	-	-	4
ITC703	Artificial Intelligence	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO-I	Institute Level Optional Course-I	3	-	-	3	-	-	3
ITL701	Network Design Lab	-	2	-	-	1		1
ITL702	Advanced Security Lab	-	2	-	-	1		1
ITL703	Intelligence System Lab	-	2	-		1		1
ITL704	Android Apps Development Lab	-	2			1		1
ITM705	Project-I	-	6/8			3	-	3
	Total	19	14	-	19	7	-	26

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC701	Enterprise Network Design	20	20	20	80	3	-	-	100	
ITC702	Infrastructure Security	20	20	20	80	3	-	-	100	
ITC703	Artificial Intelligence	20	20	20	80	3	-	-	100	
ITDLO-II	Department Level Optional Course -III	20	20	20	80	3	-	-	100	
ILO-I	Institute Level Optional Course-I	20	20	20	80	3	--	-	100	
ITL701	Network Design Lab	-	-	-	-	-	25	25	--	50
ITL702	Advanced Security Lab	-	-	-	-	-	25	25	--	50
ITL703	Intelligence System Lab	--	-	-	-	--	25	25	--	50
ITL704	Android Apps Development Lab						25	25	--	25
ITM705	Project-I	-	-	-	-	-	50	25	--	75
Total		100	100	100	400		150	125	--	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VII			
ITDLO7031	Storage Area Networks	ILO7011	Product Lifecycle Management
ITDLO7032	Mobile Application Development	ILO7012	Reliability Engineering
ITDLO7033	High Performance Computing	ILO7013	Management Information System
ITDLO7034	Software Testing and Quality Assurance	ILO7014	Design of Experiments
ITDLO7035	Soft Computing	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC701	Enterprise Network Design	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC701	Enterprise Network Design	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To be familiarized with the methodologies and approaches of the network design for an enterprise network.
2. To understand the network hierarchy and use modular approach to network design for an enterprise network.
3. To understand the campus design and data center design considerations for designing an enterprise campus.
4. To study Enterprise Edge WAN Technologies and design a WAN using them
5. Designing an IP addressing plan and selecting a Route protocol for an enterprise network.
6. To design enterprise network for given user requirements in an application.

Course Outcomes: Student should be able to:

1. Understand the customer requirements and Apply a Methodology to Network Design
2. Structure and Modularize the Network
3. Design Basic Campus and Data Center Network.
4. Design Remote Connectivity
5. Design IP Addressing and Select suitable Routing Protocols for the Network
6. Compare Openflow controllers and switches with other enterprise networks.

Pre-requisite: Computer Networks

Detailed syllabus:

University of Mumbai, B. E. (Information Technology), Rev 2016

173

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	<ol style="list-style-type: none"> 1. OSI Reference Model and TCP/IP Protocol Suite 2. Routing IP Addresses 3. Internetworking Devices 	02	
I	Applying a Methodology to Network Design:	The Cisco Service Oriented Network Architecture, Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites, Using the Top-Down Approach to Network Design, The Design Implementation Process.	08	CO1, CO6
II	Structuring and Modularizing the Network:	Network Hierarchy, Using a Modular Approach to Network Design, <i>Services Within Modular Networks, Network Management Protocols and Features</i>	09	CO2, CO6
III	Designing Basic Campus and Data Center Networks	Campus Design Considerations, Enterprise Campus Design, Enterprise Data Center Design Considerations	09	CO3, CO6
IV	Designing Remote Connectivity	Enterprise Edge WAN Technologies, WAN Design, Using WAN Technologies, Enterprise Edge WAN and MAN Architecture, Selecting Enterprise Edge Components, Enterprise Branch and Teleworker Design.	09	CO4, CO6
V	Designing IP Addressing in the Network & Selecting Routing Protocols	Designing an IP Addressing Plan, Introduction to IPv6, Routing Protocol Features, Routing Protocols for the Enterprise, Routing Protocol Deployment, <i>Route</i> Redistribution, Route Filtering, Redistributing and Filtering with BGP, Route Summarization	10	CO5
VI	Software Defined	Understanding SDN and Open Flow : SDN – SDN Building		CO6

	Network	Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , POX and NOX, Open Flow in Cloud Computing, Case study: how SDN changed Traditional Enterprise network Design	05	
--	---------	---	----	--

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.
3. CCDA Cisco official Guide
4. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky

References:

1. Top-Down Network Design (Networking Technology) 3rd Edition, [Priscilla Oppenheimer](#) ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, [Shaun Hummel](#)

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory and should cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC702	Infrastructure Security	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC702	Infrastructure Security	20	20	20	80	--	--	100	

Course Objectives: Students will try :

1. To understand underlying principles of infrastructure security
2. To explore software vulnerabilities, attacks and protection mechanisms
To learn security aspects of wireless network infrastructure and protocols
3. To investigate web server vulnerabilities and their countermeasures
4. To develop policies for security management and mitigate security related risks in the organization
5. To Learn the different attacks on Open Web Applications and Web services.
6. To Learn the different security policies.

Course Outcomes: Students will be able to:

1. Understand the concept of vulnerabilities, attacks and protection mechanisms
2. Analyze and evaluate software vulnerabilities and attacks on databases and operating systems
3. Explain the need for security protocols in the context of wireless communication
4. Understand and explain various security solutions for Web and Cloud infrastructure
5. Understand, and evaluate different attacks on Open Web Applications and Web services
6. Design appropriate security policies to protect infrastructure components

Prerequisite: Computer Networks, Cryptography and Network Security

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction	Cyber-attacks, Vulnerabilities, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC,MAC, RBAC, ABAC, BIBA, Bell La Padula), Authentication and Access Control Services- RADIUS, TACACS, and TACACS+	6	CO1

II	Software Security	<p>Software Vulnerabilities:</p> <p>Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits</p> <p>Operating System Security:</p> <p>Memory and Address Protection, File Protection Mechanism, User Authentication.</p> <p>Linux and Windows: Vulnerabilities, File System Security</p> <p>Database Security:</p> <p>Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security</p>	12	CO2
III	Wireless Security	Mobile Device Security- Security Threats, Device Security, GSM, UMTS and 4G Security, IEEE 802.11xWireless LAN Security, VPN Security, Wireless Intrusion Detection System (WIDS)	9	CO3
IV	Cloud Security	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth	8	CO4
V	Web Security	Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, DNS Attacks, Web Service Security, Secure Electronic Transaction, Email Attacks, Web Server Security as per OWASP, Firewalls, Penetration Testing	12	CO4, CO5
VI	Information Security and Risk Management	Security Policies, Business Continuity Plan, Risk Analysis, Incident Management, Legal System and Cybercrime, Ethical Issues in Security Management.	5	CO6

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wiley

Reference Books:

1. Web Application Hackers Handbook by Wiley.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. CCNA Security Study Guide, Tim Boyle, Wiley
4. Introduction to Computer Security, Matt Bishop, Pearson.
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O’Riely

Assessment:**Internal Assessment for 20 marks:****Consisting of Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC703	Artificial Intelligence	04 Hr/Week		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC703	Artificial Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
3. To review the different stages of development of the AI field from human like behavior to Rational Agents.
4. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
5. To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. that play an important role in AI programs.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

Course Outcomes: Students will be able to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing to problems leading to understanding of cognitive computing. .

Prerequisite: Programming, Data Structures.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Knowledge of any programming language, Data structures.	2	--
I	Introduction to Intelligent Systems and Intelligent Agents	Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent.	07	CO 1 CO 2
II	Search Techniques	Uninformed Search: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. Informed Search: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*, Constraint Satisfaction Programming: Crypto Arithmetic, Map Coloring, N-Queens. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	11	CO 2 CO 3
III	Knowledge and Reasoning	A Knowledge Based Agent, Overview of Propositional Logic, First Order Predicate Logic, Inference in First Order Predicate Logic: Forward and Backward Chaining, Resolution.	10	CO 4
IV	Planning	Introduction to Planning, Planning with State Space Search, Partial Ordered planning, Hierarchical Planning, Conditional Planning.	06	CO 4
V	Uncertain Knowledge and Reasoning	Uncertainly, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks, Simple Inference in Belief Networks.	06	CO 5
VI	Natural Language	Language Models, Natural Language for Communication:	10	CO 6

	Processing	Syntactic Analysis, Augmented Grammars and Semantic Interpretation, Machine Translation. Overview of Cognitive Computing: Foundation of Cognitive Computing, List of Design Principles for Cognitive Systems, Natural Language Processing in Support of a Cognitive System (First three chapters from Text book 3)		
--	------------	---	--	--

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition
3. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Lugar, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
2. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
5. John Kelly , Steve Hamm, Smart Machines - IBM's Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL701	Network Design Lab	--	2	--	--	2	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL701	Network Design Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To be familiarized with the requirements of an enterprise and address its major design areas
2. To recognize the hierarchical network model for the enterprise
3. Identify the networking devices and their configurations required for the design and also prepare a bill of materials
4. Propose a design for the Server Farm of an enterprise network and discuss up gradations if needed.
5. Provide suitable IP addressing plan and best possible routing protocol for an enterprise network.
6. Construct a suitable design for an enterprise network and test it using a tool.

Lab Outcomes: Students will be able to:

1. Understand the requirements of an enterprise and outline its major design areas
2. Identify functional areas to construct high level modules for enterprise architecture and analyze them.
3. Identify the networking devices, prepare a bill of materials and configure the devices as per the Core, Access and Distribution layers
4. Design the Server Farm for an enterprise network and discuss up gradations if needed.
5. Identify and select the technology for Remote site Connectivity, suitable IP addressing plan and routing protocol for an enterprise network.
6. Test and monitor the enterprise network using a tool

Prerequisite: Computer Networks.

Guidelines

1. The case study of College Campus Network must be designed as a mini project work which is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the requirements of a College campus enterprise network.
4. The students must outline the major design areas of a College campus enterprise network.
5. The students must identify the functional areas and construct high level modules for the College campus enterprise architecture.
6. The students must analyze the existing College campus enterprise network and propose up gradations to existing infrastructure.
7. The students must identify the network devices required and their locations to design a College campus enterprise network.
8. The students must configure the network devices required as per the Core Layer, Access Layer and Distribution Layer.
9. The students must Design the Server Farm for enterprise network using a configuration tool and also discuss if any other improvement is required.
10. The students must Prepare a bill of materials of all the networking devices. Develop a Request for Proposal-RFP for the enterprise network
11. The students must identify the technology for Remote Site connectivity and evaluate it as per the application requirements of the college campus enterprise network.
12. Propose a suitable IP addressing plan for the enterprise network.
13. Determine a suitable routing protocol for the enterprise network.
14. Create and Test the designed college campus enterprise network using a tool.
15. Use Nagios tool for enterprise infrastructure monitoring tool
16. Each group may present their work in various project competitions and paper presentations.
17. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide (Cisco Systems Networking Academy Program) Paperback – 2008, [Kenneth Stewart](#) , [Aubrey Adams](#), [Allan Reid](#) , [Jim Lorenz](#).

References:

1. Top-Down Network Design (Networking Technology) 3rd Edition, [Priscilla Oppenheimer](#) ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, [Shaun Hummel](#)

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITL702	Advance Security Lab	--	02	-	--	01	-	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL702	Advance Security Lab	--	--	--	--	25	--	25	50

Lab Objective: Students will try to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Lab Outcome: Students will able to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Prerequisite: Computer Networks, Cryptography and Network Security.

Hardware	Software
PC i3 or above configuration.	Kali Linux, Java, Snort, Kismet, Metasploit, Wireshark, Droidcrypt

Detail Syllabus:

Sr. No	Description	Hours	CO mapping
1	Exploring Kali Linux and the inbuilt tools for reconnaissance and ethical hacking.	2	LO3
2	Implementation and analysis of SQL injection Attack	4	LO1
3	Implementation of Buffer overflow attack and its analysis using Splint, Cppcheck etc.	2	LO1
4	Setting up personal Firewall using Iptables	2	LO4
5	Exploring wireless security tools like Kismet, NetStumbler etc.	2	LO2
6	Performing a penetration testing using Metasploit	2	LO3
7	Exploring Router security, access lists using packet tracer	2	LO2
8	Exploring VPN security using Packet tracer	2	LO2
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+	2	LO5

10	Install and use a security app on an Android mobile (e.g. Droidcrypt)	2	LO2
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data	2	LO3
12	Configuration of mod Security, core rule set on apache server.	2	LO2

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL703	Intelligence System Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL703	Intelligence System Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try:

1. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
2. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques.
3. To make students understand various AI methods like searching and game playing and how to apply them to solve real applications
4. To explain to students the basic issues of knowledge representation and Logic so as to build inference engines
5. To impart a basic understanding of some of the more advanced topics of AI such as planning.
6. To understand Bayes networks, natural language processing and introduce concept of cognitive computing.

Course Outcomes: Students will be able to:

1. Design the building blocks of an Intelligent Agent using PEAS representation .
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing and cognitive computing for creation of domain specific ChatBots.

Hardware	Software
PC i3 or above configuration.	Java Python

Detailed syllabus:

Module No.	Detailed Content	Hours	LO Mapping
1	Tutorial exercise for a) Design of Intelligent System using PEAS. b) Problem Definition with State Space Representation	2	LO 1, LO 2
11	Implementation of Uninformed and Informed Search Algorithms.	6	LO 2
111	Implementation of CSP and Game playing algorithms .	4	LO 3
IV	a) Assignment on Predicate Logic, for forward and backward reasoning and resolution. b) Design of a Planning system using STRIPS.	4	LO 4
V	Implementation of Bayes' Belief Network.	2	LO 5
VI	Mini project Construction of a domain specific ChatBot using Natural Language Processing techniques. (Applications can include : Medical Diagnosis, Personal Shopping Assistant, Travel Agent , Trouble shooting etc.)	8	LO6

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Lugar, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
2. John Kelly , Steve Hamm, Smart Machines - IBM's Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment + Mini-Project) + 5 Marks (Attendance) **Oral Exam:** An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL704	Android Apps Development Lab		2			1		1

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITL704	Android Apps Development Lab	--	--	--	--	25	--	25	50	

Hardware	Software
PC i3 or above configuration.	Java Android SDK

Lab Objectives: Students will try:

1. To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment.
2. To learn designing of User Interface and Layouts for Android App.
3. To learn how to use intents to broadcast data within and between Applications.
4. To use Content providers and Handle Databases using SQLite.
5. To introduce Android APIs for Camera and Location Based Service.
6. To discuss various security issues with Android Platform.

Lab Outcomes: Students will be able to:

1. Experiment on Integrated Development Environment for Android Application Development.
2. Design and Implement User Interfaces and Layouts of Android App.
3. Use Intents for activity and broadcasting data in Android App.
4. Design and Implement Database Application and Content Providers.
5. Experiment with Camera and Location Based service.
6. Develop Android App with Security features.

Prerequisite: Java Programming, Internet Programming.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do survey for different application which they can create Apps using Android.
4. Students will do Installation, configuration of Android Studio & to create AVD and also try for Cross platform Integrated Development Environment (Any Open Source Tool).
5. Students will try to Design and implement following points in their Mini Project (Android Apps)
 - a. Widget box for Android phone.
 - b. Use Layouts
 - c. Use Intents
 - d. Use Activity
 - e. Use SQLite
 - f. Use Camera
 - g. Use Location API
 - h. Generate APK file
6. Each group along with the concerned faculty shall identify a potential problem statement for Apps development, on which the study and implementation is to be conducted.
7. Each group may present their work in various project competitions and paper presentations.
8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Professional Android 4 Application Development by wrox publication
2. Android Cookbook by o'reilly
3. Beginning Android Development Wrox Press

References:

1. Android Application Development For Dummies, 2nd Edition by MichaelBurton, DonnFelker
2. Android Security –attack and defenses, AbhishekDubey and AnmolMisra by CRC Press

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM705	Project-I	--	06	--	--	3	--	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM705	Project-I	--	--	--	--	50	--	25	75

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.

6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Students will do testing and analyze in Sem VIII
11. Teams must analyze all the results obtained by comparing with other standard techniques.
12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 50 Marks (Total marks) = 45 Marks (Project-I) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-I and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7031	Storage Area Network	04	--	--	04	--	01	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7031	Storage Area Network	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Understand the need for Storage Area Network and Data protection to satisfy the information explosion requirements
2. Study storage technologies: SAN, NAS, IP storage etc., which will bridge the gap between the emerging trends in industry and academics.
3. To get an insight of Storage area network architecture, protocols and its infrastructure.
4. To study and discuss the applications of SAN to fulfill the needs of the storage management in the heterogeneous environment..
5. Study and understand the management of Storage area Networks.
6. To understand and analyze case studies on the storage area network technology

Course Outcomes: Students will able to:

1. Students will analyze the limitations of the client-server architecture and evaluate the need for data protection and storage centric architectures such as Intelligent storage system..
2. Students will understand, interpret and examine various SAN technologies.
3. Students will describe and sketch the SAN architecture and its uses.
4. Students will classify the applications as per their requirements and select relevant SAN solutions.
5. Students will understand and evaluate different SAN management strategies to fulfill business continuity requirements.
6. Students will design case studies on NAS, SAN and SAN/ NAS

Prerequisite: Computer Networks, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Networking Protocols, File system and Memory management	02	
I	Introduction to Storage System	Introduction: Storage oriented architecture, Storage Systems, Data center Infrastructure, Challenges in managing information, Information life cycle; Basics of Storage System: Components of Storage System, Disk Drive components and Performance, Components of Host; Data Protection: Raid Components and types, RAID technologies and RAID levels, RAID impact on disk performance; Intelligent Storage System” Components of ISS, Storage Provisioning and types of ISS	09	CO1
II	Network Attached Storage	Storage on Network: NAS hardware and software architecture, NAS connectivity, NAS as a Storage System; NAS Hardware devices; NAS software components; NAS connectivity options: NAS connectivity hardware and Software Architecture.	07	CO2
III	Storage Area Networks	Architecture Overview: Creating Network for storage; Hardware devices: Fibre Channel Switch, Host Bus Adaptors, Putting the Storage in SANs, Fabric Operation from a hardware perspective, SAN hardware considerations ; Software Components: The switch’s operating system, device drivers, the supporting components, considerations for SAN software ; Configuration options for SANs: Connecting into the data center, the evolving network and device connections, SAN configuration guidelines	10	CO3

IV	Applications- Putting it together	Defining the I/O workload: Storage planning and capacity planning, the definition and characterization of workloads, the business application, I/O content and workloads, Considerations for I/O workloads in storage networking ; Applying SAN solution: SAN workload characterization, applying SAN to OLTP workloads, transactional workloads; Applying NAS solution: NAS workload characterization, applying NAS to departmental workloads, enterprise web workloads and specialized workloads; Considerations when integrating SN and NAS: Differences and similarities, the need to integrate, future storage connectivity and integration	10	CO4
V	Management	Planning business continuity: Defining the environment, the role of storage networking in business continuity, storage design and implementation of the business continuity planning ; Managing availability: Availability Metrics, Implementing the plan ; Maintaining Serviceability: Tracking the configurations, Investigating the changes and closing the loop on serviceability; Capacity Planning: Storage Analysis, developing and implementing plan for storage, Modelling performance and capacity requirements ; Security considerations: Overview of Information security, Security methods, Storage Security challenges, FC SAN security, NAS security	09	CO5
VI	Case studies	Case studies on NAS, SAN, SAN/NAS	05	CO6

Text Books:

1. Storage Networks: The Complete Reference. Spalding, Robert ,Tata McGraw-Hill Education, 2003
2. “Storage Network Management and Retrieval”, Vaishali Khairnar, Nilima Dongre. Wiley

References:

1. Richard Barker, Paul Massiglia, “Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs”, Wiley India
2. Ulf Troppens, Wolfgang Muller-Friedt, Rainer Wolafka, “Storage Networks Explained” Wiley Publication
3. G. Somasundaram, Alok Shrivastava, “Information Storage and Management”, EMC Education services”, Wiley Publication

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITDLO7032	Mobile Application Development	04	-	-	04	-	-	04

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment			Avg. of two Tests					
		Test1	Test2							
ITDLO7032	Mobile Application Development	20	20	20	80	-	-	--	100	

Course Objectives: Students will try:

1. To introduce Android platform and its architecture.
2. To learn activity creation and Android UI designing.
3. To be familiarized with Intent, Broadcast receivers and Internet services.
4. To work with SQLite Database and content providers.
5. To integrate multimedia, camera and Location based services in Android Application.
6. To explore Mobile security issues.

Course Outcomes: Students will be able to:

1. Describe Android platform, Architecture and features.
2. Design User Interface and develop activity for Android App.
3. Use Intent , Broadcast receivers and Internet services in Android App.
4. Design and implement Database Application and Content providers.
5. Use multimedia, camera and Location based services in Android App.
6. Discuss various security issues in Android platform.

Prerequisite: Internet Programming, Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of HTML5,CSS3 & XML	02	-
I	Introduction to Android and Architecture of	Introduction of Android platform, Android features ,Android Marketplace, Evolution of Android OS, Android	07	CO1

	Android	Application Architecture, Developing for Android, Developing for Mobile and Embedded Devices, Android Development Tools		
II	Applications, Activities and Building User Interface	Application: Application Manifest File, Externalizing Resources, Android Application Lifecycle and Android Application Class. Android Activity: Creating activities, Activity lifecycle and Android Activity classes. User Interface: Fundamental Android UI Design, Layouts, Fragments, Designing UI with views, Creating new views, widget toolbox, Adapters.	09	CO2
III	Intents, Broadcast receiver and Internet Resources	Introducing Intents, Linking Activities Using intents , Calling Built-in Applications Using intents , Displaying notifications, Creating Intent Filters and Broadcast Receivers, Downloading and Parsing Internet Resources, Using the Download Manager, Internet Services, Connecting to Google App Engine, Downloading Data Without Draining the Battery	09	CO3
IV	Data Persistence and Content Providers	Introducing Android Databases, Introducing SQLite, Content Values and Cursors, Working with SQLite Databases, Parsing an XML document , Parsing JSON data . Creating Content Providers, Using Content Providers, Adding Search to Your Application, Native Android Content Providers	09	CO4
V	Audio, Video , Camera, Maps, Geocoding and Location Based services	Playing Audio and Video, Manipulating Raw Audio, Using Audio , Using the Camera for Taking Pictures, Recording Video, Using Media Effects , Adding Media to the Media Store. Using Location-Based Services , Using the Emulator with Location-Based Services, Selecting a Location Provider, Finding Your Current Location, Location Updates, Proximity Alerts, Geocoder, Map-Based Activities, Displaying Maps	08	CO5
VI	Securing and Publishing Android Application	Android Security Model, Android's Manifest Permissions, Mobile Security Issues, Recent Android Attacks, Pen Testing Android. Preparing for Publishing, Deploying	08	CO6

		APK Files		
--	--	-----------	--	--

Text Books:

1. Professional Android 4 Application Development, Retomeier, by wrox publication,
2. Android Security –attack and defenses, AbhishekDubey and AnmolMisra by CRC Press
3. Beginning Android Application Development, Wei-meng lee, by wrox publication

References:

1. Android Application Development For Dummies, 2nd Edition by Michael Burton, DonnFelker
2. Android Cookbook by o'reilly

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory and should cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO7033	High Performance Computing	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & oral	Oral	Total
		Internal assessment			Avg. of two Tests					
		Test1	Test2							
ITDLO7033	High Performance Computing	20	20	20	80	--	--	--	100	

Course Objectives: Students will try to:

1. Learn the concepts of parallel processing as it pertains to high-performance computing.
2. Learn to design parallel programs on high performance computing.
3. Discuss issues of parallel programming.
4. Learn the concepts of message passing paradigm using open source APIs.
5. Learn different open source tools.
6. Learn the concepts of Multi-core processor.

Course Outcomes: Students will be able to:

1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.
6. Design algorithms suited for Multicore processor and GPU systems using OpenMP and CUDA

Prerequisite: Computer Organization

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO mapping
1	Introduction	Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation), Parallel Architectures: Interconnection network, Processor Array, Multiprocessor	7	CO1
2	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	7	CO2
3	Parallel Algorithm Design	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Basic Communication operations: Broadcast and Reduction Communication types	12	CO3
4	Performance Measures	Performance Measures : Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks	5	CO4
5	Fundamental Design Issues in HPC	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations,	12	CO5

		One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication, Introduction to OpenMP,		
6	General Purpose Graphics Processing Unit(GPGPU)	CUDA enabled GPGPU, GPGPU architecture, GPGPU programming using CUDA, Introduction to CUDA Programming	9	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , “Introduction to Parallel Computing”, Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2010.
3. Edward Kandrot and Jason Sanders, “CUDA by Example – An Introduction to General Purpose GPU Programming”, Addison-Wesley Professional ©, 2010.
4. Georg Hager, Gerhard Wellein, “Introduction to High Performance Computing for Scientists and Engineers”, Chapman & Hall / CRC Computational Science series, 2011.

Reference Books:

1. Michael J. Quinn, “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, “Scalable Parallel Computing: Technology, Architecture, Programming”, McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, “High- Performance Computing: Paradigm and Infrastructure” Wiley, 2006.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7034	Software Testing and Quality Assurance	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment			Avg. of two Tests					
		Test1	Test2							
ITDLO7034	Software Testing and Quality Assurance	20	20	20	80	--	--	--	100	

Course Objectives: Students will try to learn:

- 1 Basic software debugging methods.
- 2 White box testing methods and techniques.
- 3 Black Box testing methods and techniques.
- 4 Designing test plans.
- 5 Different testing tools (familiar with open source tools)
- 6 Quality Assurance models.

Course Outcomes: Students will be able to:

1. Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.
2. Implement various test processes for quality improvement
3. Design test planning.
4. Manage the test process
5. Apply the software testing techniques in commercial environment
6. Use practical knowledge of a variety of ways to test software and an understanding of some of the trade-offs between testing techniques.

Prerequisite: Software Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts	02	--
I	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high level design, Verification of low level design, validation.	09	CO1
II	Testing Techniques	Dynamic Testing: Black Box testing: boundary value analysis, equivalence class testing, state table based testing, cause-effect graphing based testing, error guessing. White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, regression testing produces quality software, regression testability, objectives of regression testing, regression testing types, define problem, regression testing techniques.	08	CO2 CO3
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification. Software Metrics: need, definition and classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow	08	CO4

		matrix used for testing, function point and test point analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization its type , techniques and measuring effectiveness.		
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc.	09	CO1 CO5
V	Testing for specialized environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing	08	CO2 CO3
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO 9126 quality characteristics, ISO9000:2000, Software quality management	06	CO6

Text Books :

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication

References :

1. Effective Methods for Software Testing , third edition by Willam E. Perry, Wiley Publication
2. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , Dreamtech press

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7035	Soft Computing	04	--	01	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7035	Soft Computing	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To familiarize with soft computing concepts.
2. To introduce the fuzzy logic concepts, fuzzy principles and relations.
3. To Basics of ANN and Learning Algorithms.
4. Ann as function approximation.
5. Genetic Algorithm and its applications to soft computing.
6. Hybrid system usage, application and optimization.

Course Outcomes: Students will be able to:

1. List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2. Explain the concepts and meta-cognitive of soft computing.
3. Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4. Outline facts to identify process/procedures to handle real world problems using soft computing.
5. Evaluate various techniques of soft computing to defend the best working solutions.
6. Design hybrid system to revise the principles of soft computing in various applications.

Prerequisite: NIL

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Probability and Statistics, C++/Java/ Matlab	02	

		programming.		
I	Fuzzy Set Theory	<p>Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Fuzzy composition Fuzzification and Defuzzification: Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification methods</p>	06	CO1 CO2
II	Fuzzy Rules, Reasoning, and Inference System	<p>Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.</p>	06	CO1 CO2
III	Neural Network-I	<p>Introduction: What is a Neural network? Fundamental Concepts, Basic Models of Artificial Neural Networks, Artificial Intelligence and Neural Networks, McCulloch-Pitts Neuron Learning: Error-Correction Learning, Memory based Learning, Hebbian learning, Competitive Learning, Boltzmann Learning Perceptron: Perceptron Learning Rule, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable sets.</p>	09	CO1 CO2
IV	Neural Networks -II	<p>Back propagation: Multilayered Network Architecture, Back propagation Algorithm, Practical Consideration in implementing the Back propagation Algorithm. Back propagation and XOR problem. Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-center-Off-surround Networks, Building blocks of Adaptive Resonance, Substrate of resonance, Structural details of the resonance Model, Adaptive Resonance Theory I (ART I), Neurophysiological Evidence for ART Mechanism Character Recognition: Introduction, General Algorithm Architecture for Character Recognition: Binarization, Preprocessing, Filters, Smoothing, Skew Detection and Correction, Slant Correction, Character Normalization, Thinning, Segmentation, Multilingual OCR by Rule-Based Approach and ANN</p>	10	CO3 CO6

		Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network: Inputs, Outputs, Identification Results of Multilingual OCR		
V	Genetic Algorithm	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?, A Simple Genetic Algorithm Genetic Algorithms at Work—a Simulation by hand, Grist for the Search Mill—Important Similarities, Similarity Templates (Schemata), Learning the Lingo. Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited, The Two-armed and й-armed Bandit Problem, How Many Schemata Are Processed Usefully? The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyperplanes, Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work? Mapping Objective Functions to Fitness Form, Fitness Scaling, Codings, A Multiparameter, Mapped, Fixed-Point Coding, Discretization, Constraints. Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges, Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph Results of Handwriting Recognition: Effect of Genetic Algorithms, Distance Optimization, Style Optimization	10	CO1 CO3 CO6
VI	Hybrid Computing	Introduction, Neuro-Fuzzy Hybrid Systems, Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFS Architecture, Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network, Advantages of Neuro-Genetic Hybrids, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids	09	CO4 CO6

Text Books:

1. . S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007, ISBN: 10: 81-265-1075-7.
2. J.-S. R. Jang, C. –T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence, PHI Learning Private Limited-2014
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004/2007
4. Simon Haykin, Neural Networks A Comprehensive Foundation, Second Edition, Pearson Education-2004
5. David E. Goldberg, Genetic Algorithms, in search, optimization and Machine Learning, Pearson

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing, CRC Press, Taylor & Francis Group, 2010.
2. Genetic Algorithms and Genetic Programming Modern Concepts and Practical Applications © 2009 Michael Affenzeller, Stephan Winkler, Stefan Wagner, and Andreas Beham, CRC Press
3. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson

Assessment:**Internal Assessment for 20 marks:**

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1 will be compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO7011	Product Life Cycle Management	03

Course Objectives: Students will try :

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to :

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	ProductDesign: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques,	05

	Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07

05	Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
06	Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	<p>Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research</p> <p>Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis</p> <p>Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.</p> <p>Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem</p> <p>Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</p>	14
02	<p>Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population</p>	05
03	<p>Simulation: Introduction, Methodology of Simulation, Basic Concepts,</p>	05

	Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyber line Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008-TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of	06

	casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yongg – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10

04	<p>Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.</p> <p>General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.</p>	10
05	<p>Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.</p>	04
06	<p>Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources</p>	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Demonstrate understanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	07

4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	<p>Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education</p> <p>Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom</p>	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington

9. How, E., Normative Ethics in Planning, *Journal of Planning Literature*, Vol.5, No.2, pp. 123-150
10. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, *Planning Theory and Practice*, Vol. 4, No.4, pp.395 – 407

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC801	Big Data Analytics	4	-	-	4	-	-	4
ITC802	Internet of Everything	4	-	-	4	-	-	4
ITDLO-IV	Department Level Optional Course-IV	4	-	-	4	-	-	4
ILO-II	Institute Level Optional Course-II	3	-	-	3	-	-	3
ITL801	Big Data Lab	-	2	-	-	1		1
ITL802	Internet of Everything Lab		2			1		1
ITL803	DevOps Lab	-	2	-	-	1		1
ITL804	R Programming Lab	-	2	-		1		1
ITM805	Project-II	-	16			8	-	8
	Total	15	24	-	15	12	-	27

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in				
		Test 1	Test 2	Avg.						
ITC801	Big Data Analytics	20	20	20	80	3	-	-	-	100
ITC802	Internet of Everything	20	20	20	80	3	-	-	-	100
ITDLO-IV	Department Level Optional Course-IV	20	20	20	80	3	-	-	-	100
ILO-II	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
ITL801	Big Data Lab						25	25	-	50
ITL802	Internet of Everything Lab	-	-	-	-	-	25	25		50
ITL803	DevOps Lab	-	-	-	-	-	25	--	25	50
ITL804	R Programming Lab	-	-	-	-	-	25	--	25	50
ITM805	Project-II						100	50	--	150
Total		80	80	80	320	--	200	100	50	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VIII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VIII			
ITDLO8041	User Interaction Design	ILO8021	Project Management
ITDLO8042	Information Retrieval Systems	ILO8022	Finance Management
ITDLO8043	Knowledge Management	ILO8023	Entrepreneurship Development and Management
ITDLO8044	Robotics	ILO8024	Human Resource Management
ITDLO8045	Enterprise Resource Planning	ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC801	Big Data Analytics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC801	Big Data Analytics	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To introduce to the students several types of big data like social media, web graphs and data streams.
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes: Student will be able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
5. Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.
6. Design and implement successful Recommendation engines for enterprises.

Prerequisites: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Data Mining, database Systems, Algorithms	02	--
I	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	03	CO 1
II	Introduction to Big Data Frameworks: Hadoop, NOSQL	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Overview of : Apache Spark, Pig, Hive, Hbase, Sqoop What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Mongo DB	10	CO 2
III	MapReduce Paradigm	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step . Illustrating use of MapReduce with use of real life databases and applications.	09	CO 3
IV	Mining Big Data Streams	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter	07	CO 5

		<p>Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm.</p>		
V	Big Data Mining Algorithms	<p>Frequent Pattern Mining : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and MapReduce. Clustering Algorithms: CURE Algorithm. Canopy Clustering, Clustering with MapReduce Classification Algorithms: Parallel Decision trees, Overview SVM classifiers, Parallel SVM, K-Nearest Neighbor classifications for Big Data, One Nearest Neighbour.</p>	10	CO 4
VI	Big Data Analytics Applications	<p>Link Analysis : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. Mining Social- Network Graphs : Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map-Reduce. Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.</p>	11	CO 4 CO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications,
2. Anand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press.
3. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
4. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
5. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC802	Internet of Everything	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC802	Internet of Everything	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To learn the concepts of IOT.
2. To identify the different technology.
3. To learn different applications in IOT.
4. To learn different protocols used in IOT.
5. To learn the concepts of smart city development in IOT.
6. To learn how to analysis the data in IOT.

Course Outcomes: Student will be able to:

1. Apply the concepts of IOT.
2. Identify the different technology.
3. Apply IOT to different applications.
4. Analysis and evaluate protocols used in IOT.
5. Design and develop smart city in IOT.
6. Analysis and evaluate the data received through sensors in IOT.

Prerequisites: IOT Lab, Sensor Lab, Wireless Network.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	What are sensors, Sensor family, Architecture of single node sensor?	02	--
I	Introduction	Introduction, History of IOT, Objects in IOT, Identifier in the IOT, Technologies in IOT	03	CO 1
II	RFID Technology	Introduction, principle of RFID, components of RFID system: RFID tag, Reader, RFID middleware,	8	CO 2

		Issues etc.		
III	RFID Applications	Introduction, concepts and technology: RFID, transponder, RFID architecture, RFID applications i.e. logistics and supply chain, production, monitoring and maintenance, product safety, quality and information, access control and tracking and tracing of individuals, payment, loyalty, household etc. Hardware, Hardware issues, protocols: pure aloha, slotted aloha, frame slotted aloha, tree protocols, tree splitting algorithms, binary search algorithms, bitwise arbitration protocols. Main query tree protocols.	09	CO2 CO 3
IV	Wireless Sensor Networks	History and context, Node, connecting nodes, networking nodes, securing communication, standards and Fora. Networking and the Internet - IP Addressing, Protocols - MQTT, CoAP, REST Transferring data	09	CO2 CO3 CO4
V	Mobility and Settings.	Introduction, localization, mobility management, localization and handover management, technology considerations, performance evaluation, simulation setup, performance results. Identification of IOT (data formats. IPV6, identifiers and locators, tag etc.)	10	CO4 CO5
VI	Data Analytics for IoE	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study - Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.	11	CO5 CO6

Text Books:

- 1 Internet of Things connecting objects to the web, by Hakima Chaouchi, Wiley.
2. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madiseti.

Reference Books:

- 1 The Internet of Things (MIT Press) by Samuel Greengard.
- 2 The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
- 3 RFID and the Internet of Things, by Herve chabanne, Wiley

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL801	Big Data Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL801	Big Data Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the tools required to manage and analyze big data like Hadoop, NoSql
2. To impart knowledge of Map reduce paradigm to solve complex problems Map-Reduce.
3. To introduce several new algorithms for big data mining like classification, clustering and finding frequent patterns.
4. To introduce to the students several types of big data like social media, web graphs and data streams.
5. To identify various sources of Big data
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Lab Outcomes: Students will be able to:

1. Demonstrate capability to use Big Data Frameworks like Hadoop
2. Program applications using tools like Hive, pig, , NO SQL and MongoDB for Big data Applications
3. Construct scalable algorithms for large Datasets using Map Reduce techniques
4. Implement algorithms for Clustering, Classifying and finding associations in Big Data
5. Design and implement algorithms to analyze Big data like streams, Web Graphs and Social Media data and construct recommendation systems.
6. Apply the knowledge of Big Data gained to fully develop a BDA applications for real life applications.

Prerequisite: Java, Python

Requirement

Hardware	Software
PC i3 or above, 8 GB RAM	Virtual Machine, Hadoop Frame work, NOSQL and MongoDB Compilers

Detailed syllabus:

Module	Detailed Content	Hours 2hrs	LO Mapping
1	Assignment on Study of Hadoop ecosystem	02	LO 1
2	Programming exercises on Hadoop Using Hive, Pig, Hbase Sqoop NOSQL, MongoDB	04	LO 2
3	Implementing simple algorithms in Map-Reduce Matrix multiplication, Aggregates, joins, sorting, searching etc.	04	LO3
4	Implementing Algorithms using MapReduce (Any 2) <ul style="list-style-type: none"> • Implementing Frequent Item set Mining • Implementing Clustering algorithms • Implementing Classification Algorithms 	06	LO 4
5	Big Data Applications (Any 2) <ul style="list-style-type: none"> • Implementing Analytics on data streams • Implementing Social Network Analysis Algorithms • Implementing Web Graph Algorithms • Implementing recommendation Engines 	05	LO 5
6	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining d) Recommendation Engines (list of datasets also given in the text book)	05	LO 5 LO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications,
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
4. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage, Addison Wesley

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL802	Internet of Everything Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL802	Internet of Everything Lab	--	--	--	--	25	--	25	50

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Hard disk	1. Ubuntu or Linux Desktop OS 2. VMware 3. Cooja contiki or any open source software 4. Cupcarbon	1. Internet Connection

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.

4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the
 - a. Concept
 - b. Importance
 - c. Interdisciplinary
 - d. Challenges
 - e. Various applications/smart objects
 - f. Major Players/Industry, Standards.
4. The students must understand the IoT Architecture:
 - a. Node Structure: Sensing, Processing, Communication, Powering
 - b. Networking: Topologies, Layer/Stack architecture
 - c. Communication Technologies: Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Discuss data rate, range, power, computations/bandwidth, QoS
 - d. Smartness - Signal Processing/Analytics: Impact on Power/Energy savings, dynamic networks, simple case studies
 - e. IoT Fabricator: Introduction to Embedded electronics, fabricating electronics, Communication Network requirements, Data processing challenges – recreation, IP/security, Challenges
 - f. Hands-on in IoT: Projects based on some Hardware (Raspberry pi, Arduino, Intel, IITH Mote, Smartphones), Software (Contiki, TinyOS, Android), IoT Fabricator etc. can be used.
5. The students may do will visit different websites to identify their IOT topic for the mini project.
6. The students may do survey for different application using different types of sensors for their mini project.

7. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.
8. Design your own circuit board using multiple sensors etc.
9. Installation, configure and manage your sensors in such away so that they can communicate with each other.
10. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.
11. Each group will identify the Hardware and software requirement for their mini project problem statement.
12. Create and interface using Mobile/Web to publish or remotely access the data on Internet.
13. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.
14. Each group may present their work in various project competitions and paper presentations.
15. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
4. Internet of Things (A Hands-on-Approach) , Vijay Madiseti , Arshdeep Bahga

References:

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, Daniel Minoli John Wiley & Sons
3. Contiki Cooja User Guide.
4. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
5. Recent research/white papers

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL803	DevOps Lab	--	2	--	--	--	--	01

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITL803	DevOps Lab	--	--	--	--	25	25	--	50	

Lab Objectives: Students will try:

1. To understand the concept of DevOps with associated technologies and methodologies.
2. To be familiarized with Jenkins, which is used to build & test software Applications & Continuous integration in Devops environment.
3. To understand different Version Control tools like GIT, CVS or Mercurial
4. To understand Docker to build, ship and run containerized images
5. To use Docker to deploy and manage Software applications running on Container.
6. To be familiarized with concept of Software Configuration Management & provisioning using tools like Puppet, Chef, Ansible or Saltstack.

Lab Outcomes: Students will be able to:

1. Remember the importance of DevOps tools used in software development life cycle
2. Understand the importance of Jenkins to Build, Deploy and Test Software Applications
3. Examine the different Version Control strategies
4. Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker
5. Summarize the importance of Software Configuration Management in DevOps
6. Synthesize the provisioning using Chef/Puppet/Ansible or Saltstack.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration	1. Windows or Linux Desktop OS for Client machines	1. Internet Connection for each PC with at least 2 MBPS

1. Intel Core i3/i5/i7 Processor with Intel VT-X support 2. 4 GB RAM 3. 500 GB Harddisk 4. Gigabit Ethernet (GbE) network interface card (NIC)	2. CentOS/Fedora/Ubuntu/Redhat Server OS for One Server 3. JDK 1.8 or higher 4. Netbeans or Eclipse 5. OpenSSH	bandwidth.
---	---	------------

Prerequisite Subjects: Operating System, Virtualization, Cloud Computing, Java and Web Programming, and Software Engineering.

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	To Understand the Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications.	02	--
I	Build & Test Applications with Continuous Integration	To Install and Configure Jenkins to test, and deploy Java or Web Applications using Netbeans or eclipse.	04	LO 1 LO2
II	Version Control	To Perform Version Control on websites/ Softwares using different Version control tools like RCS/ CVS/GIT/Mercurial (Any two)	04	LO 1 LO 3
III	Virtualization & Containerization	To Install and Configure Docker for creating Containers of different Operating System Images	04	LO 1 LO 4
IV	Virtualization & Containerization	To Build, deploy and manage web or Java application on Docker	04	LO 1 LO 4
V	Software Configuration Management	To install and configure Software Configuration Management using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 5

VI	Provisioning	To Perform Software Configuration Management and provisioning using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 6
----	--------------	---	----	--------------

Text Books:

1. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
2. Len Bass, Ingo Weber, Liming Zhu, "DevOps, A Software Architects Perspective", Addison-Wesley-Pearson Publication.
3. John Ferguson Smart, "Jenkins, The Definitive Guide", O'Reilly Publication.
4. Learn to Master DevOps by Star EduSolutions.

References:

1. Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication

Term Work:

Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL804	R Programming Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITL804	R Programming Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To provide an overview of a new language R used for data science.
2. To introduce students to the R programming environment and related eco-system and thus provide them with an in-demand skill-set, in both the research and business environments
3. To introduce the extended R ecosystem of libraries and packages
4. To demonstrate usage of as standard Programming Language.
5. To familiarize students with how various statistics like mean median etc. can be collected for data exploration in R
6. To enable students to use R to conduct analytics on large real life datasets.

Lab Outcomes: students will be able to:

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages
3. Extract data from files and other sources and perform various data manipulation tasks on them.
4. Code statistical functions in R.
5. Use R Graphics and Tables to visualize results of various statistical operations on data .
6. Apply the knowledge of R gained to data Analytics for real life applications.

SOFTWARE requirements:

1. The R statistical software program. Available from: <https://www.r-project.org/>
2. RStudio an Integrated Development Environment (IDE) for R. Available from: <https://www.rstudio.com/>

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
0	Prerequisites - Any programming Language like Java Python. Basic statistics. Data Mining Algorithms	--	--
I	Introduction: Installing R on personal machines. installing R and RStudio. <ul style="list-style-type: none"> The basic functionality of R will be demonstrated, Variable types in R. Numeric variables, strings and factors. Accessing the help system. Retrieving R packages. Basic data types and operations: numbers, characters and composites. Data entry and exporting data 	02	LO 1, LO 2, LO 3
II	Data structures: vectors, matrices, lists and data frames.	04	LO1, LO 3
III	R as a programming language: <ul style="list-style-type: none"> Grouping, loops and conditional execution, Functions Exploratory data analysis <ul style="list-style-type: none"> Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot 	04	LO 1, LO 4
IV	Graphics in R <ul style="list-style-type: none"> Graphics and tables Working with larger datasets Building tables with aggregate Introduction to ggplot2 graphics 	06	LO 3
V	Regression and correlation <ul style="list-style-type: none"> Simple regression and correlation, Multiple regression Tabular data and analysis of Categorical data 	02	LO 4
VI	R for Data Science (Mini Project) Implementing a mini project using any data mining or big data analytics algorithm in R <ul style="list-style-type: none"> Extracting data from a large Dataset Exploratory analysis Using Mining algorithm Visualizations and interpretation of results 	06	LO 5, LO 6

Text Books:

1. URL: <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf> (Online Resources)
2. R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
3. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
4. R Programming For Dummies by Joris Meys Andrie de Vries, Wiley Publications

References:

1. Hands-On Programming with R by Golemund, O Reilly Publications
2. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.
3. R for Data Science Learning Dan Toomey December 2014 Packt Publishing Limited

Term Work:

Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM805	Project-II	--	16	--	--	8	--	8

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Term Work	Practical & Oral	Oral	Total
		Internal assessment			Avg. of two Tests					
		Test1	Test2							
ITM805	Project-II	--	--	--	--	100	--	50	150	

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.
6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Students will do testing and analyze in Sem VIII
11. Teams must analyze all the results obtained by comparing with other standard techniques.
12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 100 Marks (Total marks) = 95 Marks (Project-II) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-II and Presentation.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8041	User Interaction Design	04	--	--	04	--	--	04

Course code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITDLO8041	User Interaction Design	20	20	20	80	--	--	--	100	

Course Objectives: Students will try to:

- 1 To stress the importance of good interface design.
- 2 To understand the importance of human psychology as well as social and emotional aspect in designing good interfaces.
- 3 To learn the techniques of data gathering, establishing requirements, analysis and data interpretation.
- 4 To learn the techniques for prototyping and evaluating user experiences.
- 5 To understand interaction design process.
- 6 To bring out the creativity in each student – build innovative applications that are usable, effective and efficient for intended users.

Course Outcomes:

1. Students will be able to identify and criticize bad features of interface designs.
2. Students will be able to predict good features of interface designs.
3. Students will be able to illustrate and analyze user needs and formulate user design specifications.
4. Students will be able to interpret and evaluate the data collected during the process.
5. Students will be able to evaluate designs based on theoretical frameworks and methodological approaches.
6. Students will be able to produce/show better techniques to improve the user interaction design interfaces.

Prerequisite: Web technologies, Software Engineering, Experiences in designing interfaces for applications and web sites. Basic Knowledge of designing tools and languages like HTML , Java etc.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering concepts and any programming Language	02	--
I	Introduction to Interaction Design	Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience	09	CO1,CO 2
II	Understanding and Conceptualizing Interaction Cognitive aspects and Social, Emotional Interaction	Understanding the Problem Space and Conceptualizing Design, Conceptual Model, Interface Types Cognitive aspects, Social Interaction and the Emerging Social Phenomena, Emotions and the User Experience, Expressive and Frustrating Interfaces, Persuasive Technologies	09	CO2,CO 3
III	Data Gathering, Establishing Requirements, Analysis, Interpretation and Presentation	Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis	09	CO4
IV	Process of Interaction Design, Prototyping, Construction,	Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies	09	CO4
V	Design rules and Industry standards	Design principles, Principles to support Usability, Standards and Guidelines, Golden rules and Heuristics, ISO/IEC standards	08	CO5
VI	Evaluation Techniques and Framework	The Why, What, Where and When of Evaluation, Types of Evaluation, case studies, DECIDE Framework, Usability Testing, conducting	06	CO5,CO 6

		experiments, Field studies, Heuristic Evaluation and walkthroughs, Predictive models.		
--	--	---	--	--

Text Books:

1. *Interaction Design*, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. *Human Computer Interaction*, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.

References:

1. The UX Book, by Rex Hartson and Pardha S Pyla.
2. Donald A. Norman, “The design of everyday things”, Basic books.
3. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8042	Information Retrieval System	04	--	--	04	--	--	04

Course Code	CourseName	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of twoTests					
ITDL O804 2	Information Retrieval System	20	20	20	80	--	--	--	100

Course Objectives: students will try:

1. To learn the fundamentals of information retrieval system.
2. To classify various Information retrieval models.
3. To demonstrate the query processing techniques and operations
4. To compare the relevance of query languages for text and multimedia data
5. To evaluate the significance of various indexing and searching techniques for information retrieval.
6. To develop a effective user interface for information retrieval.

Course Outcomes:

1. Students will define and describe the objectives the basic concepts of Information retrieval system.
2. Students will evaluate the taxonomy of different information retrieval models.
3. Students will solve and process text and multimedia retrieval queries and their operations
4. Students will evaluate text processing techniques and operations in information retrieval system.
5. Students will demonstrate and evaluate various indexing and searching techniques.
6. Student will design the user interface for an information retrieval system.

Prerequisite: Data structures and algorithms

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment (Prerequisite syllabus should not be considered for paper setting) Indexing and searching Algorithms	02	
I	Introduction	Motivation, Basic Concepts, The retrieval Process, Information System: Components, parts and types on information system; Definition and objectives on information retrieval system	05	CO1
II	IR Models	Modeling: Taxonomy of Information Retrieval Models, Retrieval: Adhoc and filtering, Formal Characteristics of IR models, Classic Information Retrieval, Alternative Set Theoretic models, Probabilistic Models, Structured text retrieval Models, models for Browsing; Multimedia IR models: Data Modeling	09	CO2
III	Query Processing and Operations	Query Languages: Keyword based Querying, Pattern Matching, Structural Queries, Query Protocols; Query Operations: User relevance feedback, Automatic local analysis, Automatic global analysis, Multimedia IR Query Languages	10	CO3
IV	Text Processing	Text and Multimedia languages and properties: Metadata, Markup Languages, Multimedia; Text Operations: Document Preprocessing, Document Clustering, Text Compression, Comparing Text Comparison Technique	10	CO4
V	Indexing and Searching	Inverted files, Other indices for text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression; Multimedia IR: Indexing and Searching:- Spatial Access Methods, A Generic Multimedia indexing approach, One-	11	CO5

		dimensional time series, Two dimensional color images, Automatic Feature extraction; Searching Web: Challenges, Characterizing the web, Search Engines. Browsing, Meta searches, Searching needle in haystack, Searching using Hyperlinks		
VI	User interface and visualization	Human Computer interaction, the information access process, starting points, query specifications, context, using relevance judgments, interface support for the search process	05	CO6

Text Books:

- 1.Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley
2. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher
3. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India

References:

1. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
2. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8043	Knowledge Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITDLO8043	Knowledge Management	20	20	20	80	--	--	--	100	

Course Objectives:

1 Establish a foundation of key terms and concepts, historical events and contributions, organizational benefits, and guiding principles on which to build greater understanding of knowledge management

2 Appreciate the role and use of knowledge for individuals, as well as organizations and institutions.

3 Increase information and understanding about knowledge transfer using low- and high technology strategies

4 Explore the future of knowledge management and its influence on our jobs, communities, and society

Course Outcomes: After completion of the course the learner will be able to

- 1) Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
- 2) Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems
- 3) Evaluate the impact of technology including telecommunications, networks, and Internet/intranet role in managing knowledge.
- 4) Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy
Ponder KM's current and future impact on individuals, organizations and society at large

Prerequisite: An introductory course in IT/ IS

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Meaning of data, information, knowledge and expertise Meaning of epistemology, Types of Knowledge - Subjective & Objective views of knowledge, procedural Vs. Declarative, tacit Vs. explicit, general Vs. specific.	3
I	Introduction to Knowledge Management	What is Knowledge? Types of expertise – associational, motor skill, – theoretical Characteristics of knowledge – explicitness, codifiability, teachability, specificity Reservoirs of knowledge, Meaning of Knowledge Management, Forces Driving Organizational issues in KM, KM Systems & their role Relevance of KM in today’s dynamic & complex environment Future of Knowledge Management	5
II	Knowledge management system life cycle	Challenges in Building KM Systems – Conventional versus KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka’s Model of Knowledge Creation and Transformation. Knowledge Architecture.	8
III	KM Solutions for capture, sharing & applications	KM Processes, KM Systems, Mechanisms & Technologies Knowledge Capturing Techniques: Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory Grid- Concept Mapping –Blackboarding, Nominal Group Technique, Delphi method,	9
IV	Knowledge codification	Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer’s Skill Sets – System Testing and Deployment – Knowledge Testing – Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation.	9
V	Knowledge transfer and sharing	Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.	9

VI	KM Impact	Dimensions of KM Impact – People, Processes, Products & Organizational Performance Factors influencing impact – universalistic & contingency views Assessment of KM Impact – Qualitative & quantitative measures Identification of appropriate KM solutions, Ethical Legal and Managerial Issues	9
----	-----------	--	---

Text Books:

1. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies . Prentice Hall. ISBN: 0-13-109931-0.
2. Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13-034820-1
3. Donald Hislop, Knowledge Management in Organizations, Oxford 2nd Edition. Ian Watson (2002).
4. Shelda Debowski, Knowledge Management, Wiley India Edition.

References:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.
2. Stuart Barnes (Ed.) (2002). Knowledge Management Systems Theory and Practice. Thomson Learning.
3. Kimiz Dalkir, Knowledge Management in Theory and Practice, Elsevier, Butterworth Hinemann.
4. Applying Knowledge Management: Techniques for Building Corporate Memories. Morgan Kaufmann. ISBN: 1558607609.

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8044	Robotics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITDLO8044	Robotics	20	20	20	80	--	--	--	100	

Course Objectives: Students will try:

1. Learn the basic concepts of Robots.
2. Learn the concepts of Kinematics of Robotics.
3. Learn the concepts of Motions, velocities and dynamic analysis of force.
4. Learn the concepts of Motion planning.
5. Learn the concepts of Trajectory Planning
6. Learn the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Course Outcomes: Student will be able to:

1. Apply the basic concepts of Robots.
2. Apply and evaluate the concepts of Kinematics of Robotics.
3. Apply the Motions, velocities and dynamic analysis of force.
4. Apply and evaluate Motion planning.
5. Apply the concepts of Trajectory Planning
6. Apply the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Prerequisites: Basic of Electrical Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basics of Electrical Engineering	02	--
I	Fundamentals	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate	04	CO1

		frames, workspace, applications		
II	Kinematics of Robotics	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	11	CO2
III	Motions, velocities and dynamic analysis of force	Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian. Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames	09	CO3
IV	Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	08	CO5
V	Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	04	CO4
VI	Potential Functions, Visibility Graphs and Coverage Planning	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods. Cell Decomposition, Localization and Mapping	14	CO6

Text Books:

1. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011
2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion –Theory, Algorithms and Implementations”, Prentice-Hall of India

References:

1. Mark W. Spong & M. Vidyasagar, “Robot Dynamics & Control”, Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition, 2013.

Assessment:

Internal Assessment for 20 marks:

Consisting of Two Compulsory Class Tests

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8045	Enterprise Resource Planning	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory Marks					Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test2	Avg. of two Tests						
ITDLO8045	Enterprise Resource Planning	20	20	20	80	--	--	--	100	

Course Objectives: Students will try:

1. To learn the basic concepts of ERP.
2. To learn different technologies used in ERP.
3. To learn the concepts of ERP Manufacturing Perspective and ERP Modules.
4. To learn what are the benefits of ERP
5. To study and understand the ERP life cycle.
6. To learn the different tools used in ERP.

Course Outcomes: Student will be able to:

1. Understand the basic concepts of ERP.
2. Identify different technologies used in ERP.
3. Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules.
4. Discuss the benefits of ERP
5. Understand and implement the ERP life cycle.
6. Apply different tools used in ERP.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basics of software.	02	--
I	Introduction to ERP	Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model	04	CO1

II	ERP Technologies	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System	06	CO2
III	ERP Manufacturing Perspective and ERP Modules	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management. Finance, Plant Maintenance, Quality Management, Materials Management.	10	CO3
IV	Benefits of ERP	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability	08	CO4
V	ERP Life cycle	Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode).	06	CO5
VI	E-Commerce to E-business	E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techno enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications. Enterprise resource planning the E-business Backbone Enterprise architecture, planning, ERP usage in Real world, ERP Implementation, Future of ERP applications, memo to CEO ,E-Procurement, E- Governance, Developing the E-Business Design.	16	CO6

		JD Edwards-Enterprise One. Microsoft Dynamics-CRM Module.		
--	--	--	--	--

Text Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

References:

1. Guide to Planning ERP Application, Annetta Clewto and Dane Franklin, McGraw-Hill, 1997
2. The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
3. E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota

Assessment:

Internal Assessment for 20 marks:

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions, each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus.**
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	5.1 Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting,	8

	<p>engaging with all stakeholders of the projects. Team management, communication and project meetings.</p> <p>5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit.</p> <p>5.3 Project Contracting Project procurement management, contracting and outsourcing,</p>	
06	<p>6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects.</p> <p>6.2 Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.</p>	6

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	<p>Overview of Indian Financial System: Characteristics, Components and Functions of Financial System.</p> <p>Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.</p> <p>Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market</p> <p>Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges</p>	06
02	<p>Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.</p> <p>Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.</p>	06
03	<p>Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.</p> <p>Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.</p>	09
04	<p>Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)</p>	10

	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8023	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	Indian Environment for Entrepreneurship: key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	<p>Introduction to HR</p> <ul style="list-style-type: none"> • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues. 	5
02	<p>Organizational Behavior (OB)</p> <ul style="list-style-type: none"> • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study 	7
03	<p>Organizational Structure & Design</p> <ul style="list-style-type: none"> • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and 	6

	<p>stress.</p> <ul style="list-style-type: none"> • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies. 	
04	<p>Human resource Planning</p> <ul style="list-style-type: none"> • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods 	5
05	<p>Emerging Trends in HR</p> <ul style="list-style-type: none"> • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation. 	6
06	<p>HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries)</p> <p>Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals</p> <p>Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act</p>	10

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. [Corporate Social Responsibility in India \(2015\) by BidyutChakrabarty, Routledge, New Delhi.](#)

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data	08

	j. Preparation of Research Report	
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	04

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8028	Digital Business Management	03

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	<p>Introduction to Digital Business-</p> <p>Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts</p> <p>Difference between physical economy and digital economy,</p> <p>Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services)</p> <p>Opportunities and Challenges in Digital Business,</p>	09
2	<p>Overview of E-Commerce</p> <p>E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement</p> <p>B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals</p> <p>Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing</p> <p>EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC</p>	06

3	<p>Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system</p> <p>Application Development: Building Digital business Applications and Infrastructure</p>	06
4	<p>Managing E-Business-Managing Knowledge, Management skills for e-business, Managing Risks in e –business</p> <p>Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications</p>	06
5	<p>E-Business Strategy-E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition</p> <p>(Process of Digital Transformation)</p>	04
6	<p>Materializing e-business: From Idea to Realization-Business plan preparation</p> <p>Case Studies and presentations</p>	08

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vincenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en) OECD Publishing

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000

6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.