ESTD : 1946

THE NATIONAL INSTITUTE OF ENGINEERING

(An Autonomous Institute under Visvesvaraya Technology University, Belagavi)

Scheme of Teaching &
Blown-up Syllabus for Semester-V
(2022 admitted batch)
Academic Year 2024-25

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Department Vision

"The Department will provide quality and value based education to produce innovative world-class computing engineers and will enhance quality research for the betterment of society"

Department Mission

- To impart high quality training, education and competence in information science domain through best-in class faculty and facilities

- To produce globally acceptable information science graduates who can contribute professionally to the industry and research activities by offering courses on emerging technologies.

- To provide platforms to work effectively and innovatively in multi-disciplinary domain.

Programme Educational Objectives

PEO 1: Professionally successful in the field of Information and emerging technologies.
PEO 2: Successful in pursuing higher studies at globally recognized institutions.

Programme Specific Objectives

PSO 1: Apply the knowledge of information Systems in the field of Engineering to provide Solution through programming skills
PSO 2: Collaborate and communicate effectively with professionals in the field of computing, involve in continuous learning and address societal issues

Programme Outcomes

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The National Institute of Engineering

Scheme of Teaching & Examination (2022 Scheme)

Department: Information Science & Engineering

B.E. 2022 Admitted Batch

Semester : V

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week			Examination				Credits
						L	T	P	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	BIS501	Software Engineering & Project Management	IS&E	IS&E	3	0	0	3	100	100	100	**3**
2	IPCC	BIS502	Computer Networks	IS&E	IS&E	3	0	2	3	100	100	100	**4**
3	PCC	BIS503	Theory of Computation	IS&E	IS&E	3	2	0	3	100	100	100	**4**
4	PCCL	BISL504	Data Visualization Lab	IS&E	IS&E	0	0	2	3	50	50	100	**1**
5	PCC	BIS505	Cloud Computing	IS&E	IS&E	3	0	0	3	100	100	100	**3**
6	PEC	BIS516X	Professional Elective Course - Group I	IS&E	IS&E	3	0	0	3	100	100	100	**3**
7	PROJ	BIS586	Minor Project	IS&E	IS&E	0	0	2	-	50	-	50	**1**
8	AEC	BRMIS557	Research Methodology and IPR	IS&E	IS&E	2	0	0	2	50	50	100	**2**
9	MC	BESK508	Environmental Studies	TD: Civil	Civil	1	0	0	-	50	-	50	**1**
10	MC	BNSK559	National Service Scheme (NSS)	NSS Coordinator		0	0	2	_	100	_	100	**0**
		BPEK559	Physical Education (PE) (Sports & Athletics)	PED									
		BYOK559	Yoga	Yoga Teacher									
Total										**800**	**600**	**900**	**22**

Professional Elective Course - Group I

BIS516A	Computer Vision	BIS516C	Distributed Systems
BIS516B	Artificial Intelligence	BIS516D	Unix System Programming

Course Code: BIS501 **Course:** Software Engineering and Project Management
Credits: 3 **L:T:P** 3:0:0
CIE: 100 Marks **SEE: 100** Marks
SEE Hours: 3 **Max. Marks:** 100

Prerequisites if any	NIL
Learning objectives	1. Understand the software development lifecycle and its phases. 2. Gain proficiency in software project management strategies. 3. Understand the project management life cycle.

Course Outcomes:

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

COs	Course Outcomes
CO1	Describe different software models.
CO2	Analyze system models using UML diagrams.
CO3	Explain Software testing and development
CO4	Discuss project planning techniques and project metrics.
CO5	Outline the significance of software testing tools.

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Introduction: Software Crisis, Need for Software Engineering. Professional Software Development	2	-	-
1.2	Software Engineering Ethics. Case Studies. Software Processes: Models: Waterfall Model	2	-	-
1.3	Incremental Model and Spiral Model, continuous integration cycle	2	-	-
1.4	Process activities. Requirements Engineering: Requirements Engineering Processes.	2	-	-
	Module – 2	2	-	-
2.1	System Models: Context models, Interaction models, Structural models	2	-	-
2.2	Behavioral models, Model-driven engineering, Design and Implementation: Introduction to RUP	2	-	-
2.3	Design Principles. Object-oriented design using UML. Design patterns.	2	-	-
	Module – 3	-		-
3.1	Software Testing: Development testing, Test-driven development, Release testing, User testing	2		-
3.2	Test Automation, Software Evolution: Evolution processes,	2		-
3.3	Program evolution dynamics Software maintenance	2		-
3.4	Legacy system management.	2	-	-
	Module – 4		-	-
4.1	Agile Software Development: Coping with Change, The Agile Manifesto: Values and Principles	2	-	-
4.2	Agile methods: SCRUM and Extreme Programming, Plan-driven and agile development	2		-
4.3	Agile project management.	2		-
4.4	Project Planning: Software pricing, Plan-driven development, Project scheduling: Estimation techniques	2		-
	Quality management: Software quality, Reviews and inspections,	2		-
	Module – 5	-		-
5.1	Software testing tools: QTP 10, Silk test, Test complete	2	-	-
5.2	Telerik, Selenium	2	-	-
5.3	Project management softwares: Taiga	2	-	-
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours			
	Total No. of Practical Hours			

Textbooks:

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2018
2. Rahul Shende: Software automation testing tools for beginners SPD Publishers, 2015

Reference Books:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India Web Reference

Online Resources:

1. NPTEL Software engineering course.
https://nptel.ac.in/courses/106101061

Course Code: BIS502
Credits: 4
CIE: 100 Marks
SEE Hours: 3

Course: Computer Networks
L:T:P 3:0:2
SEE: 100 Marks
Max. Marks: 100

Prerequisites if any	Students need to be aware of layered concepts of OSI and TC/IP models, and the working of lower layers
Learning objectives	1. To learn the aspects of internet addresses, IP datagram, IP versions 2. To learn the importance of mapping of IP to physical address and vice versa using protocols , error control and group related protocols 3. To learn the routing methods and algorithms in the network layer 4. To learn the transport layer protocols, with flow, error, congestion control and QoS mechanisms 5. To learn the various services provided at the application layer.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	Course Outcomes
CO1	Discuss the concepts of IP address, Classes, IP Datagram of two versions.
CO2	Describe the mapping of logical to physical addresses and vice versa, and also the different protocols for allocating IP addresses, error handling and group handling.
CO3	Describe the forwarding and routing algorithms.
CO4	Discuss the protocols for process to process communication and congestion control algorithms.
CO5	Discuss the importance of various application related services and protocols.

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Introduction, IPv4 Addresses: Address Space, Notations, Classful IP Addressing, Classless Addressing, Address Translation (NAT). IPv6 Addresses: Structure, Address Space	3	-	
1.2	Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network	1	-	
1.3	IPv4: Datagram, Fragmentation, Checksum, options	2	-	
1.4	IPv6: advantages ,packet format, comparison between IPv4 and IPv6 headers, transition from IPv4 to IPv6	2	-	
	Module – 2		-	
2.1	Mapping Logical to Physical Address: ARP, Mapping Physical to Logical Address	1.5	-	
2.2	RARp, BOOTP, and DHCP	1.5	-	
2.3	ICMP: Types of Messages, Message Format, Error Reporting messages, Query messages.	3	-	
2.4	IGMP: Group Management, IGMP Messages, Message Format, IGMP Operation.	2	-	
	Module – 3		-	
3.1	Delivery: Direct Versus Indirect Delivery	1	-	
3.2	Forwarding: Forwarding Techniques, Forwarding Process, Routing Table. Unicast Routing Protocols:	2	-	
3.3	Optimization, Intra- and Interdomain Routing, RIP	1	-	
3.4	Distance Vector Routing, Link State Routing.	3	-	
	Module – 4		-	
4.1	Process-To-Process Delivery: Client/Server Paradigm, Multiplexing and Demultiplexing, Connectionless Versus Connection-Oriented Service, Reliable Versus Unreliable, protocols	2	-	
4.2	User Datagram Protocol (UDP): Well-Known Ports for UDP, User Datagram, Checksum, UDP Operation, Use of UDP	1.5	-	
4.3	TCP: TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, error control, SCTP: SCTP services, SCTP features	3	-	

4.4	Data traffic, traffic profiles, Congestion: Network Performance. Congestion Control: Open-Loop Congestion Control, Closed-Loop Congestion Control.	1.5	-	
	Congestion Control in TCP. Quality of Service: Flow Characteristics, Flow Classes. Techniques To Improve QoS: Scheduling, Traffic Shaping.	2	-	
	Module – 5			
5.1	Name Space: Flat Name Space, Hierarchical Name Space. Domain Name Space: Label, Domain Name, Domain.	1.5	-	
5.2	Distribution Of Name Space: Hierarchy of Name Servers, Zone	1	-	
5.3	Root Server, Primary and Secondary Servers. DNS in the Internet: Generic Domains, Country Domains, Inverse Domain. Resolution	2	-	
5.4	Remote Logging, Electronic Mail, and File Transfer:Remote Logging, Telnet. Electronic Mail: Architecture, User Agent, Message Transfer Agent. FTP	2.5	-	
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		0	
	Total No. of Practical Hours			

List of experiments

Sl. No.	Program / Experiment	Mapping CO(s)
1.	Prepare a detailed report on different devices available in various layers of computer network architecture.	CO1
2.	Given a valid IPV4 address, separate the Network and Host ID part and determine the class of the given IPV4 address. (Using a C program)	CO1
3.	Write a program to generate a CRC Code for a frame carrying 40bytes of data. The program should also detect the error for the received data.	CO2
4.	Simulate the working of distance vector routing algorithm using Bellman-Ford's algorithm.	CO3
5.	Write a client-server program in TCP / IP in which the server-side code listens for connect requests, and whatever message the client sends the server converts it to uppercase and sends it back.	CO4

6.	Using Wireshark capture, filter and inspect packets. a. Capture Ethernet / Wi-Fi Packets. b. Filter TCP, UDP, HTTP, DNS Packets. b. Capture and filter for telnet that captures traffic to and from a given host.	CO4
7.	Simulate the working of sliding window protocol for flow control in computer networks. (Using a C program)	CO4
8.	Using ESTINET / NETSIM simulator / Cisco packet tracer carry out the following exercises (topology will be given during the experiment conduction.) a. Draw a wired network topology (using hub, switch and router) and set the parameters like "Bandwidth", "Bit Error Rate", and "Propagation Delay" and run the simulation to calculate the number of packets dropped. b. Draw a topology of a wired network of networks having hosts, routers, switches and set the specified parameters. Calculate the number of packets delivered to a host from different networks.	CO3
10.	Analyze packet headers details with wireshark.	CO1
11.	Analyze whether an email received is spam or not.	CO1

Textbooks:

1. Data Communications and Networking, Behrouz A Forouzan, 4th Edition, McGraw-Hill, 2006.

Reference Books:

1. Data and Computer Communication, William Stallings, 8th Edition.
2. Computer Networks: A Systems Approach, Larry L Peterson and Bruce S David, Elsevier, 4th Edition.

Online Resources:

EBOOK:

1. http://www.faadooengineers.com/threads/3176-Computer-Networks-FREE-Ebook-covering-full-semester-syllabus

MOOCs:

1. http://www.omnisecu.com/tcpip/tcpip-model.php
2. http://www.omnisecu.com/tcpip/index.php

Course Code: BIS503 **Course: Theory of Computations**
Credits: 4 **L:T:P:S 3:2:0**
CIE: 100 **Marks** SEE: 100 **Marks**
SEE Hours: 3 **Max. Marks:** 100

Prerequisites if any	- NIL -
Learning objectives	1. Understand basic principle of different Finite automata tools. 2. Learn construction of Push Down Automata and Turing Machines.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	Course Outcomes
CO1	Analyze the basic principle of deterministic, non-deterministic finite automata and the properties of regular language.
CO2	Apply the concepts of Context free grammar.
CO3	Construct Push Down Automata and Turing Machines.

Mapping with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO 1	PSO2
CO1	3	2	3	3	1	1	2	1	1	2	2	2		3	2
CO2	3	2	2	3	2	1	2	1	1	2	2	2		2	2
CO3	3	2	3	3	2	2	3	1	2	2	2	2		3	2

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1	No. of Lecture Hours	No. of Tutorial Hours	Self Learning Hours
1.1	**Introduction to Finite Automata-** the central concepts of Automata theory.	2	-	-
1.2	Deterministic finite automata.	2	1	-
1.3	Non- deterministic finite automata, and application.	2	1	-
1.4	Finite automata with Epsilon transition	1	-	-
1.5	Extended transitions and Languages for Є- NFA.	1	-	-
Module – 2				
2.1	**Regular Expressions and Languages, Properties of Regular Languages-** Regular Expression, Finite Automata and Regular Expressions.	2	1	-
2.2	Proving languages not to be regular	2	-	-
2.3	Closure Properties of Regular Languages	1	-	-
2.4	Decision Properties of Regular Languages	1	-	-
2.5	Equivalence and minimization of automata	2	1	-
Module – 3				
3.1	**Context-Free Grammars and Languages -** Context-free grammars	2	-	-
3.2	Parse trees, Applications	2	1	-
3.3	Ambiguity in grammars and languages	2	-	
3.4	Removing Ambiguity in grammars	2	1	-
Module – 4				
4.1	**Pushdown Automata -** Definition of the Pushdown automata	2	-	-
4.2	The languages of a PDA	1	1	-
4.3	Equivalence of PDA's and CFG's	2	-	-
4.4	Deterministic Pushdown Automata	3	1	
Module – 5				
5.1	**Introduction to Turing Machines –** The Turing Machine	2	-	-
5.2	Programming techniques for Turing machines	2	1	-
5.3	Extension to the basic Turing machine, Restricted Turing Machine.	1	1	-
5.4	Undecidability – A Language that is not recursively enumerable- code for TM	2	-	-
5.5	An undecidable problem that is RE, Post's Correspondence problem	1	-	-
			-	-
Total No. of Lecture Hours		40	-	
	Total No. of Tutorial Hours		10	-

Textbooks:

1. Introduction to Automata Theory, Languages and Computation, J.P. Hopcroft, Rajeev Motwani, J.D. Ullman, Pearson Education, III Edition, 2014.

Reference Books:

1. Introduction to the Theory of Computation, Michael Sipser, Cenege learning, 3rd edition, 2014.
2. Introduction to Languages and Theory of Computation, John Martin, Tata McGraw Hill, 3rd Edition, 2010.
3. Introduction to Computer Theory, Daniel I.A., Cohen, John Wiley and Sons, Inc, 2nd Edition, 2011.
4. An Introduction to Formal Languages and Automata, Peter Linz, Narosa Publishing House, 4th Edition, 2010.

Online Resources:

1. Finite Automata and Regular Expressions: Problems and Solutions by Stefan Hollos, J. Richard Hollos, Abrazol Publishing, 2013.
2. https://www.coursera.org/course/automata.

Course Code: BISL504 **Course: Data Visualization Lab**
Credits: 1 **L:T:P:S 0:0:2**
CIE: 50 Marks **SEE: 50 Marks**
SET Hours: 3 **Max. Marks:** 50

Prerequisites if any	Python, Basis of data analytics
Learning objectives	1. Understand the importance of data visualization decision making 2. Learn about categories of visualization and application areas 3. Familiarize with the data visualization tools 4. Gain knowledge of effective data visuals to solve workplace problems

Course Outcomes:
On successful completion of the course, the student will be able to:

CO1	Investigate, compare, and select appropriate data visualization tools, and demonstrate the ability to understand and prepare diverse datasets for effective visualization.
CO2	Plan, design, and execute a comprehensive data visualization project, aligning visualizations with project goals
CO3	Create insightful and interactive visualizations and dashboards, integrating user-friendly features that allow dynamic data exploration
CO4	Effectively communicate and collaborate by presenting and defending projects

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Project-based laboratory:

Students should undertake a project that aligns with the specified guidelines, which encompass exploring visualization tools, selecting and analyzing a dataset, preparing a comprehensive project proposal, and developing an interactive dashboard. Adhering to the timeline for each phase, actively participating in progress discussions, and emphasizing clarity and creativity in the final presentation are crucial for achieving successful project outcomes.

Timeline	Work to be carried out	Marks (CIE)
Weeks 1-2	Introduction & Tool Exploration	5
Weeks 3	Dataset Selection & Understanding	5
Weeks 4	Project Proposal	5
Weeks 5-7	Implementation	10
Weeks 8-9	Dashboard Creation	15
Weeks 10	Final Project Presentation	10
	Total Marks	**50**

Semester End Test will be conducted for 50 marks and scaled down to 10 marks with rubrics as given below:

Project Demonstration with modifications : 20 marks
Project report preparation : 20 marks
Presentation and viva : 10 marks

Textbooks:

1. Data visualization with python: create an impact with meaningful data insights using interactive and engaging visuals, Mario Dobler, Tim Grobmann, Packt Publications, 2019
2. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, Ryan Sleeper, Oreilly Publications, 2018

Reference Books:

1. Data Visualization with R: 111 Examples by Thomas Rahlf, Springer, 2020

Online Resource:

1. Coursera course link for data visualization using tableau:
https://www.coursera.org/specializations/data-visualization

Course Code: BIS505 **Course: Cloud Computing**
Credits: 3 **L:T:P:S 3:0:0**
CIE: 100 Marks **SEE: 100 Marks**
SEE Hours: 3 **Max. Marks:** 100

Prerequisites if any	Knowledge of networking and storage. Basics of Operating Systems.
Learning objectives	1. Understand the fundamentals of cloud computing and its service models. 2. Gain understanding of deploying and managing applications on major cloud platforms. 3. Learn about the security, best practices and compliance in cloud environments.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	Course Outcomes
CO1	Explain the open-source platforms for private cloud.
CO2	Illustrate Cloud computing applications and paradigms.
CO3	Describe the importance of virtualization.
CO4	Explain knowledge in cloud resource virtualization and scheduling.
CO5	Discuss the security of virtualization and the security risks posed by cloud paradigm.

Mapping with POs and PSOs

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1: Introduction, Cloud Infrastructure	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities	2		
1.2	Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services	2		
1.3	Open-source software platforms for private clouds, Cloud storage diversity and vendor lock- in	2		
1.4	Energy use and ecological impact, Service level agreements, User experience	2		
	Module – 2: Cloud Computing: Application Paradigms			
2.1	Challenges of cloud computing, Architectural styles of cloud computing	2		
2.2	Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper	2		
2.3	The Map Reduce programming model, A case study: The Grep The Web application	2		
2.4	Cloud for science and engineering, High-performance computing on a cloud	2		
	Module – 3: Cloud Resource Virtualization			
3.1	Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines	2		
3.2	Performance and Security Isolation, Full virtualization and paravirtualization	2		
3.3	Hardware support for virtualization, Case Study: Xena VMM based paravirtualization	2		
3.4	Optimization of network virtualization, vBlades, Performance comparison of virtual machines	2		
	Module – 4: Cloud Resource Management and Scheduling			
4.1	Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud	2		
4.2	Stability of a two- level resource allocation architecture, Feedback control based on dynamic thresholds	2		
4.3	Coordination of specialized autonomic performance managers, Autility-based model for cloud-based Web services	2		
4.4	Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, borrowed virtual time	2		
	Module – 5: Cloud Security, Cloud Application Development			
5.1	Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment	2		
5.2	Trust, Operating system security, Virtual machine Security, Security of virtualization	2		
5.3	Security risks posed by shared images. Security risks posed by a management OS	2		
5.4	A trusted virtual machine monitor, Amazon web services: EC2 instances	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		00	
	Total No. of Practical Hours			00

Textbooks:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.

Reference Books:

1. Rajkumar Buyya,James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2. John W Rittinghouse, James F Ransome: Cloud Computing Implementation, Management and Security, CRC Press 2013.

Online Resources:

1. Dr. Tim Chou's book on cloud computing- https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxjbG91ZGNvbXB1dGluZ2NsYXNzfGd4OjJjNjlhMTdjNDdkZGE0N2Y&pli=1

MOOC's:

1. https://www.coursera.org/course/cloudcomputing

Course Code: BIS516A **Course: Computer Vision**
Credits: 3 **L:T:P:S 3:0:0**
CIE: 100 Marks **SEE: 100 Marks**
SEE Hours: 3 **Max. Marks:** 100

Pre requisites if any	Nil
Learning objectives	1. To introduce students the fundamentals of image formation; 2. To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; 3. To develop an appreciation for various issues in the design of computer vision and object recognition systems; and 4. To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	Course Outcomes
CO1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision
CO2	Describe known principles of human visual system
CO3	Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition
CO4	Suggest a design of a computer vision system for a specific problem

Mapping with POs and PSOs:

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

3–Strong 2–Medium 1–Low

Course Structure

	Module–1	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Image Formation Models:	2	0	0
1.2	Monocular imaging system	2	0	0
1.3	Orthographic& Perspective Projection, Camera model and Camera calibration	2	0	0
1.4	Binocular imaging systems	2	0	0
	Module – 2			
2.1	Image Processing and Feature Extraction: Image representations (continuous and discrete)	6	0	0
2.2	Edge detection	2	0	0
	Module – 3			
3.1	Motion Estimation: Regularization theory	3	0	0
3.2	Optical computation, Stereo Vision	3	0	0
3.3	Motion estimation, Structure from motion	2	0	0
	Module – 4			
4.1	Shape Representation and Segmentation: Deformable curves and surfaces	2	0	0
4.2	Snakes and active contours	2	0	0
4.3	Level set representations, Fourier and wavelet descriptors	2	0	0
4.4	Medial representations, Multiresolution analysis	2	0	0
	Module – 5			
5.1	Object recognition: Hough transforms and other simple object recognition methods	2	0	0
5.2	Shape correspondence and shape matching	2	0	0
5.3	Principal Component analysis	2	0	0
5.4	Shape priors for recognition	2	0	0
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		00	
	Total No. of Practical Hours			00

Textbooks:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Reference Books:

1. **Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)**
2. **Haralick & Shapiro, "Computer and Robot Vision", Vol II**
3. G_erard Medioni and Sing Bing Kang "Emerging topics in computer vision"

Course Code: BIS516B **Course: Artificial Intelligence**
Credits: 3 **L:T:P 3:0:0**
CIE: 100 Marks **SEE: 100 Marks**
SEE Hours: 3 **Max. Marks:** 100

Pre requisites if any	None
Learning objectives	1. Develop an understanding of the historical context of AI and itsfundamental principles. 2. Acquire proficiency in applying basic AI principles to solve problemseffectively. 3. Familiarize oneself with the methodologies of inference, perception,knowledge representation, and learning in AI.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs	Course Outcomes
CO1	Explain the architecture and components of intelligent agents, including their interaction with the AI environment.
CO2	Apply problem-solving agents and various search strategies to solve a given problem.
CO3	Illustrate logical reasoning and knowledge representation using propositional and first order logic.
CO4	Demonstrate proficiency in representing knowledge and solving problems using first-order logic and Describe various ways to quantify uncertainty.

Mapping with Pos and PSOs:

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

Mapping Strength: Strong–3 Medium–2 Low–1

Course Structure

Sl. no	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module–1: Introduction to AI			
1.1	**Introduction:** What is AI? Foundations of AI.	2	-	-
1.2	History of Artificial Intelligence	1	-	-
1.3	The State of the Art	1	-	-
1.4	**Intelligent Agents:** Agents and environment	1	-	-
1.5	Concept of Rationality	1	-	-
1.6	The nature of environments	1	-	-
1.7	The structure of agents	1	-	-
	Module–2: Problem solving based on searching			
2.1	Problems solving Agents, Example problems	2	-	-
2.2	Searching for solutions	1	-	-
2.3	Uniformed Search strategies–Uniform cost search	1	-	-
2.4	Breadth First Search, Depth First Search	1	-	-
2.5	Depth Limited Search	1	-	-
2.6	Iterative Deepening Depth First	2	-	-
	Module–3: Heuristic Search Strategies			
3.1	Heuristic functions	1	-	-
3.2	Greedy best first search	1	-	-
3.3	A*algorithm	2	-	-
3.4	Local Search & Optimization: Hill Climbing	2	-	-
3.5	Genetic Algorithms	2	-	-
	Module–4: Logical Agents, First Order Logic			
4.1	**Logical Agents:** Knowledge–based agents	1	-	-
4.2	The Wumpus world, Logic	1	-	-
4.3	Proposition logic	1	-	-
4.4	Reasoning patterns in Propositional Logic	2	-	-
4.5	**First Order Logic:** Representation Revisited, Syntax and Semantics of First Order logic	2	-	-
4.6	Using First Order logic.	1	-	-
	Module–5: Quantifying Uncertainty			
5.1	**Inference in First Order Logic:** Propositional Versus First Order Inference	2	-	-
5.2	Unification, Forward Chaining	1	-	-
5.3	Backward Chaining, Resolution.	1	-	-
5.4	Acting under Uncertainty	1		
5.5	Probability Notation	1		
5.6	Baye's Rule and its use	2		
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3rd Edition, Pearson, 2015

Reference Book:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill, 2013
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

Online Resources:

1. Artificial Intelligence: https://nptel.ac.in/courses/106105077

Course Code: BIS516C
Credits: 3
CIE: 100 Marks
SEE Hours: 3

Course: Distributed Systems
L:T:P 3:0:0
SEE: 100 Marks
Max. Marks: 100

Prerequisites if any	Operating Systems, Computer Networks, Data Structure and Algorithms, Programming Skills and Database Systems.
Learning objectives	1. Understanding Distributed System Architectures and Models. 2. Exploring Distributed Algorithms for Synchronization, Coordination, and Consensus.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	**Course Outcomes**
CO1	To understand the principles and practices of distributed systems.
CO2	To learn about distributed system architectures and models.
CO3	To explore distributed algorithms for synchronization, coordination, and consensus.
CO4	To understand fault tolerance, security, and emerging trends in distributed systems.

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module 1: Introduction and System Models	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Introduction to Distributed Systems	2	-	-
1.2	System Models	2	-	-
1.3	Communication in Distributed Systems	2	-	-
1.4	Processes and Threads	2	-	-
	Module 2: Synchronization and Coordination			
2.1	Naming and Name Services	2	-	-
2.2	Synchronization in Distributed Systems	2	-	-
2.3	Coordination	2	-	-
2.4	Case Study: Coordination in Practice	2	-	-
	Module 3: Consistency and Replication			
3.1	Data-Centric Consistency Models	2	-	-
3.2	Client-Centric Consistency Models	2	-	-
3.3	Replica Management	2	-	-
3.4	Case Study: Distributed Databases	2	-	-
	Module 4: Fault Tolerance and Security			
4.1	Fault Tolerance	2	-	-
4.2	Consensus Algorithms	2	-	-
4.3	Security Challenges	2	-	-
4.4	Authentication and Authorization	2	-	-
	Module 5: Advanced Topics and Case Studies			
5.1	Distributed File Systems	2	-	-
5.2	Distributed Ledger Technologies	2	-	-
5.3	Emerging Trends in Distributed Systems	2	-	-
5.4	Review and Case Studies	2	-	-
	Total No. of Lecture Hours	40	-	
	Total No. of Tutorial Hours		00	-
	Total No. of Practical Hours			00

Textbooks

1. Tanenbaum, Andrew S., and Maarten Van Steen. Distributed Systems: Principles and Paradigms. Pearson, 2007.
2. Coulouris, George, Jean Dollimore, Tim Kindberg, and Gordon Blair. Distributed Systems: Concepts and Design. 5th ed., Addison-Wesley, 2011.

Reference Books

1. Kleppmann, Martin. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. O'Reilly Media, 2017.
2. Ghosh, Sukumar. Distributed Systems: An Algorithmic Approach. 2nd ed., CRC Press, 2014.
3. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed Computing: Principles, Algorithms, and Systems. Cambridge University Press, 2008.

Online Resources:

1. **Distributed Systems for Fun and Profit**
   - Website: https://book.mixu.net/distsys/
2. **MIT OpenCourseWare: Distributed Systems**
   - Website: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-824-distributed-computer-systems-engineering-spring-2006/index.htm

Course Code: BIS516D
Credits: 3
CIE: 100 Marks
SEE Hours: 3

Course: Unix System Programming
L:T:P 3:0:0
SEE: 100 Marks
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. Understand architecture of Unix Operating System. 2. Learn how to write Shell Scripts.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	Course Outcomes
CO1	Explain Unix Architecture, File system and use of Basic Commands
CO2	Illustrate Shell Programming and to write Shell Scripts
CO3	Categorize, compare and make use of Unix System Calls
CO4	Build an application/service over a Unix system.

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1: Introduction	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Unix Components/Architecture. Features of Unix. The UNIX Environment and UNIX Structure, Posix and Single Unix specification.	2		
1.2	General features of Unix commands/ command structure. Command arguments and options.	2		
1.3	Basic Unix commands such as echo, printf, ls, who, date, passwd, cal, Combining commands.	2		
1.4	Meaning of Internal and external commands. The type command: knowing the type of a command and locating it. The root login. Becoming the super user: su command.	2		
	Module – 2: File attributes and permissions			
2.1	Naming files. Basic file types/categories. Organization of files. Directory commands.	2		
2.2	File attributes and permissions, The shells interpretive cycle.	2		
2.3	Connecting commands	1		
2.4	Shell programming: Ordinary and environment variables. The .profile. Read and read only commands. Command line arguments. Exit and exit status of a command. Logical operators for conditional execution. The test command and its shortcut. The if, while, for and case control statements. The set and shift commands and handling positional parameters. The here (<<) document and trap command.	3		
	Module – 3: UNIX File APIs			
3.1	General File APIs, File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs.	2		
3.2	The Environment of a UNIX Process: main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions, UNIX Kernel Support for Processes.	3		
3.3	Process Control: Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 Functions, Race Conditions, exec Functions	3		
	Module – 4: Overview of IPC Methods			
4.1	Changing User IDs and Group IDs, Interpreter Files, system Function, Process Accounting, User Identification, Process Times, I/O Redirection.	2		
4.2	Overview of IPC Methods: Pipes, popen, pclose Functions, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores	3		
4.3	Shared Memory: Client-Server Properties, Stream Pipes, Passing File Descriptors, An Open Server-Version 1, Client-Server Connection Functions.	3		
	Module – 5: Signals and Daemon Processes			
5.1	Signals: The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction,	2		

5.2	The SIGCHLD Signal and the waitpid Function,	2		
5.3	The sigsetjmp and siglongjmp Functions, Kill, Alarm, Interval Timers, POSIX.lb Timers.	2		
5.4	Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Client-Server Model.	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		00	
	Total No. of Practical Hours			00

Textbooks:

1. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill
2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 4th Edition, Pearson Education, 2011
3. Unix System Programming Using C++ - Terrence Chan, PHI, 2012

Reference Books:

1. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.
2. Richard Blum, Christine Bresnahan: Linux Command Line and Shell Scripting Bible, 2ndEdition, Wiley,2014.

Online Resources:

1. Coursera:
   a) Linux Foundation's Introduction to Linux:
https://www.coursera.org/learn/linux
   b) Programming for Everybody (Getting Started with Python) by University of Michigan:
https://www.coursera.org/learn/python

2. edX:
   a) Linux System Administration Essentials:
https://www.edx.org/course/linux-system-administration-essentials
   b) Introduction to Linux by LinuxFoundationX:
https://www.edx.org/course/introduction-to-linux

3. Udemy:
   a) Linux System Programming Techniques and Concepts:
https://www.udemy.com/course/linux-system-programming-techniques-and-concepts/

4. MIT OpenCourseWare:
   a) Operating System Engineering:
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/

Course Code: BIS586
Credits: 1
CIE: 50 Marks
SEE Hours: NA

Course: Minor Project
L:T:P 0:0:2
SEE: NA
Max. Marks: 50

Prerequisites if any	Project Plan
Learning objectives	1. You will be able to learn to select, analyse, design and solve a real world problem.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	**Course Outcomes**
CO1	Identify areas of interest in emerging technology.
CO2	Formulate the problem and perform analysis.
CO3	Implement cost effective design methods with documentation

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Code: BRMIS557 **Course: Research Methodology and IPR**
Credits: 2 **L:T:P 2:0:0**
CIE: 50 Marks **SEE: 50 Marks**
SEE Hours: 2 **Max. Marks:** 100

Prerequisites if any	Nil
Learning objectives	1. Identify the overall process of designing a research study from its inception to its report 2. Distinguish a purpose statement, a research question or hypothesis, and a research objective.

Course Outcomes:
On successful completion of the course, the student will be able to:

COs	**Course Outcomes**
CO1	Explain the functions of the literature review in research.
CO2	Illustrate various research designs and their characteristics.
CO3	Compare various forms of intellectual property, their relevance, and business impact in the changing Global business environment.

Mapping with POs and PSOs:

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

3 – Strong 2 – Medium 1 – Low

Course Structure

	Module – 1: Research Methodology and Research Process	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Introduction, Meaning of Research, Objectives of Research, Types of Research	1		
1.2	Research Approaches, Significance of Research, Research Methods versus Methodology	1		
1.3	Research and Scientific Method, Research Process, Criteria of Good Research	2		
1.4	Defining the Research Problem: Research Problem, Selecting the Problem	2		
1.5	The Necessity of Defining the Problem, the Technique Involved in Defining a Problem	2		
	Module – 2: Reviewing the literature and Research Design			
2.1	Place of the literature review in research, How to review the literature, Writing about the literature review	2		
2.2	Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design	2		
2.3	Important Concepts Relating to Research Design, Different Research Designs,	2		
2.4	Basic Principles of Experimental Designs, Important Experimental Designs	2		
	Module – 3: Report Writing & IPR			
3.1	Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation	2		
3.2	Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports	1		
3.3	Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports	2		
3.4	Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trademark Act, 1999, The Designs Act, 2000	2		
3.5	World Intellectual Property Organization (WIPO), WIPO and WTO, Paris Convention for the Protection of Industrial Property	2		
	Total No. of Lecture Hours	25		
	Total No. of Tutorial Hours		0	
	Total No. of Practical Hours			0

Textbooks:

1. Kothari, C. R., and Gaurav Garg. *Research Methodology: Methods and Techniques*. New Age International (P) Limited, Publishers, 2019.
2. Kumar, Ranjit. *Research Methodology: A Step-by-Step Guide for Beginners*. Sage, 2019.
3. Professional Programme Intellectual Property Rights, Law, and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books:

1. Trochim, William M.K. *Research Methods: The Concise Knowledge Base*. Atomic Dog Publishing, 2005.
2. Fink, Arlene. *Conducting Research Literature Reviews: From the Internet to Paper*. Sage, 2019.

Online Resources:

1. NPTEL Course on Research Methodology Prof. Soumitro Banerjee - IISER Kolkata https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Course Code: BESK508 **Course: Environmental Studies**
Credits: 1 **L:T:P 1:0:0**
CIE: 50 Marks **SEE: NA**
SEE Hours: NA **Max. Marks:** 50

Prerequisites if any	Knowledge of Physics, Chemistry, and Biology along with concepts of Ecology and Environment at a Basic level
Learning objectives	1. Understanding the concept of Ecology and environment with the basic knowledge of science. 2. Implication of Pollution on the Environment and remedial measures.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs	**Course Outcomes**
CO1	Illustrate the relationship between human life and environment from scientific perspective and analyse the importance of natural resources.
CO2	Summarize the impact of pollution and describe the control measures and importance of various National environmental acts and regulatory bodies.
CO3	Describe the global environmental issues, explain the concept of EIA and Global environmental summits, treaties and protocol.

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1			1			2			3		1				
CO2					2							2			
CO3				2				1		3					

Mapping Strength: Strong–3 Medium– 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction and definition of Environment	1		
1.2	Man-Environment interaction	1		
1.3	Impact of man's activity on Environment	1		
1.4	Ecology, Energy/nutrient flow	1		
1.5	Ecological pyramids, Types of Food Chain, Food Web	1		
1.6	Bio geochemical cycle–Carbon Cycle	1		
1.7	Bio geochemical cycle–Nitrogen Cycle	1		
1.8	Bio geochemical cycle–Sulphur Cycle	1		
	Module – 2			
2.1	Pollutant and its classification, Introduction to Pollution, sources of pollution	1		
2.2	Water, Air, Noise pollution, nuclear hazards (Sources, effects, remedial measures standards)	1		
2.3	Solid waste and E-waste management: causes, effects and control measures of urban and industrial wastes.	1		
2.4	Environmental Laws and protection Acts: environment protection act	1		
2.5	Air (prevention and control of pollution) Act	1		
2.6	Water (prevention and control of pollution) Act,	1		
2.7	Wild life protection act,	1		
2.8	Forest conservation Act	1		
2.9	Pollution Control Boards' roles and responsibilities (CPCB and KPCB)	1		
	Module – 3			
3.1	Global environmental issues-global warming, acid rain, ozone depletion (reasons, effects, control measures)	1		
3.2	Carbon foot print and carbon trading.	1		
3.3	International environmental management standards (ISO14000).	1		
3.4	Global environmental summits, treaties and protocols (important summits).	1		
3.5	Introduction to Environmental Impact Assessment (EIA), Environmental Auditing.	1		
3.6	Sustainable environmental concepts: water conservation–rainwater harvesting	1		
3.7	Sustainable environmental concepts: water conservation-artificial recharging	1		
3.8	Sustainable environmental concepts: water conservation – water shed management	1		
3.9	Waste to energy–solid waste to energy conversion.	1		
	Total No. of Lecture Hours	**26**		
	Total No. of Tutorial Hours		**0**	**0**
	Total No. of Practical Hours			

Self- learning topics identified:

1. Land and Forest Wealth.
2. The need of Environment Education / Knowledge (from the point of view of Sustainable Development)
3. Three "R" Concepts of Waste Management.

Text books:

1. Benny Joseph **"Environmental Science and Engineering"**. Tata McGraw-Hill Publishing Company Limited.

Reference Books:

1. Gilbert M. Masters **"Introduction to Environmental Engineering and Science."** Prentice-Hall of India Pvt. Limited.
2. Edward J. Kormondy **"Concepts of Ecology"** Prentice-Hall of India Pvt. Limited.
3. P.D. Sarma **"Ecology and Environment"** Rastogi Publications.

Online Resources:

1. Introduction to Environmental Engineering and Science by NPTEL https://youtu.be/LjFt7rlCU84
2. Environmental Impact Assessment (EIA) Part-1 by NPTEL https://youtu.be/_iLdyhgFv1U
3. EIA by NPTEL https://youtu.be/yO_d6-P-ZZk
4. EIS & EIA by NPTEL https://youtu.be/ErU5DSUq3B0

Non Credit Mandatory Courses

Once opted for a course, a student has to continue in the same for the next semesters.

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Code: BNSK559
Credits: Non credit Mandatory course
L:T:P - 0:0:2
Total Marks: 100

Course: National Service Scheme (NSS)
CIE: 100 Marks
SEE: NA

Syllabus will be provided by the respective coordinator

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Code: BPEK559
Credits: Non credit Mandatory course
L:T:P - 0:0:2
Total Marks: 100

Course: Physical Education (PE)
CIE: 100 Marks
SEE: NA

Syllabus will be provided by the respective coordinator

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Code: BYOK559
Credits: Non credit Mandatory course
L:T:P - 0:0:2
Total Marks: 100

Course: Yoga
CIE: 100 Marks
SEE: NA

Syllabus will be provided by the respective coordinator

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