Course Code	15B11CI313	Semester ODD (specify Odd/Even)	Semester Fifth Session 2023-2024 Month from July –Dec 2023
Course Name	Computer Organization and Architecture		
Credits	4 (L=3, T=1)	**Contact Hours**	3-1-0

Faculty (Names)	Coordinator(s)	Dr. Hema N. (Sec. 62), Dr. Bansidhar Joshi (Sec.128)
	Teacher(s) (Alphabetically)	Amarjeet Kaur, Bansidhar Joshi, Dipty Tripathi,Hema N., Jagriti, Rashmi Kushwah, Shailesh Kumar, Varun Srivastava

COURSE OUTCOMES		COGNITIVE LEVELS
C213.1	Summarize and Classify the different computer systems based on RISC and CISC Architecture.	(Understand)Level 2
C213.2	Apply the knowledge of performance metrics to find the performance of systems.	(Apply) Level 3
C213.3	Examining various types of computers based on Instruction Set Architectures.	(Apply)Level 3
C213.4	Analyze RISC and CISC based systemdesigns for Hardwired and Microprogrammed Controller.	(Analyze) Level 4
C213.5	Apply the knowledge of pipeline, IO and cache to understand these systems. Further, analyze the performance of such systems.	(Analyze) Level 4
C213.6	Create and analyze an assembly language program of RISC and CISC-based systems.	(Evaluate) Level 5

Module No.	Title of the Module	Topics in the Module	No. of Lectures for module
1.	Introduction	Levels in architecture, Virtual machine, Evolution of multi-level machines.	2
2.	Performance of Computer	Introduction,Performance Measures For Computer System using MIPS, Clock Rate, No. of Instruction andAmdahl's Law. Numerical Related to performance measures for different specification.	4
3.	CPU Organization	Basic Computer Organization, Instruction Representation basics,Data-path and control, Instruction execution, Microinstruction.	4

4.	Data Path and Control	Introduction,Architecture of JC62, Instruction Set,Hardwired designing for JC62. Micro-programmed control designing for JC62.	4
5.	Generalized Study of Instruction Set Architecture	Stack/accumulator/register-register/register-memory type of architecture. Memory addressing techniques.	2
6.	Types of Instruction	Data movement, Arithmetic/logic, Control flow, Addressing modes. Instruction format.	2
7.	Instruction Set Architecture (ISA) of 8085	8085 Architecture, 8085 Instruction Set, 8085 Instruction Format, 8085 Addressing Modes, 8085 instruction execution and datapath. 8085 Assembly programming for simple applications.	5
8.	ISA of MIPS	MIPS Architecture, MIPS Instruction Set, MIPS Instruction Format, MIPS Addressing Modes, MIPS instruction execution and datapath. MIPS Assembly programming for simple applications.	5
9.	Memory Organization	Hierarchal memory structure, Cache memory and organization, Cache Mapping,Cache Replacement algorithms,Memory interfacing for 8085.	5
10.	I/O Organization	IO instruction format, IO Mapping, Programmed/Interrupt driven I/O, DMA controllers	3
11.	Pipelining	Introduction To Pipelining System, Pipelining in RISC based Systems (MIPS), Pipeline Hazards and its solutions.	5
12.	Multicore Architecture	Generalized study of Multicore Machines.	1
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance =10, Sincerity=05, Internal assessment/ Class Test or/and Quizzes/Mini-Project = 10).
Total	**100**

Project-based learning: In this subject, students will learn the Organization and Architecture of the different computer systems. After completing the subject, students can measure the performance of different computer systems. They can create low bit assembler applications. Along with this, they will be able to interface memory with different architectures like 8085and MIPS.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc., in the IEEE format)

Text Books

1.	M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt Ltd, 3rd Edition (updated), 30 June 2017.
2.	William Stallings, Computer Organization and Architecture–Designing for Performance, Ninth Edition, Pearson Education, 2013.
3.	John L. Hennessy and David A Patterson, Computer Architecture A Quantitative Approach, Morgan Kaufmann / Elsevier, Sixth Edition, 23rd November 2017
4.	Ramesh Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, Prentice Hall, Eight Edition, 2013.
Reference Books	
1.	Nicholas Carter, Schaum's outline of Computer Architecture, Tata McGraw Hill, Second Edition, 2014.

Course Code	15B11CI373	Semester ODD (specify Odd/Even)	Semester Second Session 2023-2024 Odd(July to December 2023)
Course Name	Computer Organization and Architecture Lab		
Credits	1	Contact Hours	2

Faculty (Names)	Coordinator(s)	Dr. Jagriti(J128), Amarjeet Kaur(J62)
	Teacher(s) (Alphabetically)	Amarjeet Kaur, Dr. Bansidhar Joshi, Dr. Jagriti, Dr. Shailesh Kumar,

COURSE OUTCOMES		COGNITIVE LEVELS
C377.1	Implementation basic ALU of 2-bit and 4-bit computer using hardwired simulation tool	Apply (Level 3)
C377.2	Initialization and fetching of data from specific memory using various addressing mode of 8085	Understand (Level 2)
C377.3	Develop 8085 assembly language programs using software interrupts and various assembler directives.	Apply (Level 3)
C377.4	Develop MIPS assembly language programs using software interrupts and various assembler directives.	Apply (Level 3)
C377.5	Create of application and its software using 8085/MIPS microprocessor or microcontrollers	Create (Level 6)

Module No.	Title of the Module	List of Experiments	CO
1.	COA Hardwired simulation tool	Realize the truth table of various gates like as AND, OR, NOT, XOR, NAND and NOR., Conversion of universal gates, Design the half adder and full adder circuits, Ripple	C377.1

		adder logic circuit, 4 x1 multiplexor circuit and realize the various input output logic based on control, 4X1 multiplexor with NAND gates logic circuits	
2.	Combinational circuits	Design the subtractor circuits with defined bit logic, Adder-subtractor logic circuits, The odd frequency divider circuits, Carry lookup adder, Carry select and carry save, Adder circuits by modifying the ripple carry adder logic given in module-1.,Timing diagram of all four adder circuits and compare their performance, Decoder circuits with defined logic, 4-bit ALU circuits with defined operation logic.	**C377.1**
3.	8085 Simulator Introduction	Understanding Hardware Specification of the **8085 Simulator** in detail, Add two 8-bit numbers from load sample program from file menu, assemble and execute it step by step and view the contents of registers and memory., Basic Data transfer instructions, Arithmetic instructions, Logical instruction of 8085 using sample programs withnote changes in flags.	**C377.2**
4.	8085 Programming (Simple)	8085 Assembly Programming: Basic Arithmetic (like addition, subtraction, multiplication, division etc), Array (sum , reverse, average copy etc) etc and explore more about Arithmetic , Logical and Flow control Instructions	**C377.2**
5.	8085 Programming (Complex)	8085 Assembly Programming: Logical and Data transfer (like Min, Max, Even/odd, Sorting etc), more complex program(like Factorial, Link list etc) , String etc and explore more about Arithmetic, Logical and Flow control Instructions	**C237.2**
6.	MIPS(MARS) Simulator (Simple)	MIPS Assembly Programming: Arithmetic (like addition, subtraction, multiplication, division etc), Logical and Data transfer (like Min, Max, Even/odd, Sorting etc), Array (sum , reverse, average copy etc)	**C377.3**
7.	MIPS(MARS) Simulator (Complex)	Complex program (Factorial, Fibonacci etc), String Operations, Translation of C control statement into MIPS(IF THEN ELSE,WHILE, FOR LOOP, SWITCH control,)and explore more about Arithmetic, Logical, Flow control Instructions using MARS Simulator.	**C377.4**
8.	Projects	Students are expected to create an hardware and software co-designed application based on 8085/ MIPS/ Other controller (like Arduino) / Small Size computer (like Raspberry Pi)programming either in assembly or high level language.	**C377.5**

Project based learning: Project in COA lab is an integral part of the lab. Student form group size 3-4, and discuss the project idea with their lab faculty before finalizing. All projects are based on hardware and hardware components like microprocessor microcontrollers (like Arduino), microcomputer (like Raspberry pi), various sensors (like temperature sensor, humidity sensor etc), cams (like webcam), etc. are used. Programming language is used as per processor/controller. Students develop projects/prototypes to interact with physical environment, control physical object with software which is base of IoT and embedded system. Students learn various processor architecture as well as their programming languages. This helps students to understand how to develop IoT based products and embedded systems.

Evaluation Criteria	
Components	**Maximum Marks**
Evaluation 1	10
Lab Test 1	20
Evaluation 2	10
Lab Test 2	20
Project	25
Attendance	15
Total	100

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
Text Book	
1.	William Stallings, Computer Organization and Architecture–Designing for Performance, 9th Edition, Pearson Education, 2013.
2.	Nicholas Carter, Schaum's outline of Computer Architecture, Tata McGraw Hill, 2017
3.	John L. Hennessy and David A Patterson, Computer Architecture A quantitative Approach, Morgan Kaufmann / Elsevier, Sixth Edition, 2017
Reference Book	
1.	Microprocessor Architecture Programming and Applications with the 8085 [HB]-6/e. 25 September 2014. by Ramesh Gaonkar .
2.	The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro-Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions : Architecture, Programming, and Interfacing. Barry B. Brey, Pearson Education India, 2009.
3.	http://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/comp_org_arc/web/
4.	http://cs.nyu.edu/~gottlieb/courses/2010s/2011-12-fall/arch/class-notes.html
5.	http://www.cse.iitm.ac.in/~vplab/courses/comp_org/LEC_INTRO.pdf
6.	http://www.cs.iastate.edu/~prabhu/Tutorial/title.html
7.	http://www.cag.csail.mit.edu/
8.	http://www.research.ibm.com/compsci/arch
9.	M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt Ltd, Fourth edition, 2002. ISBN: 81-203-0855-7.

1. CO-PO and CO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C377.1	3	3	1	1	3	1			1				2	3
C377.2	3	3	3	1	2	1			1				2	3
C377.3	3	3	3	1	3	1			1				2	3
C377.4	3	3	2	1	1			1				1	2	3
C377.5	3	3	2	1	2	1	1		2	1			2	3
NBA CODE:C377	3	3	2	1	2	1	1	1	1	1		1	2	3

Programme Name: B. Tech (CSE)	Programme Name: B. Tech (CSE)													
Semester: IV														
Course Name & Code: Computer Architecture and Organizations Lab (15B11CI373)														
CO Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C377.1	2	2	2		3	2			1	1	2	2	1	2
Reasons	The basic concepts of of basic gates, combinational circuits and ALU circuit using concepts of digital electronic's logics	Various problem domain where basic gates, combinational circuits are used to develop ALU opertions	Fundamental knowledge of basic gates, combinational circuits and ALU to design solutions for complex problems		Use of virtual lab simulation tool 'cold vl64' developed by IIT KGP to implement.	Understanding of designing basic ALU can be extended to understand and design other useful processors			Assignments will be assigned to apply concepts of digital electronics to implement ALU. Moreover, the concept can be used in	ALU design concepts can be used as part of project supported with presentation and design document for learning effective communicatio	The concepts will be used as fundamental to develop the project and understand the engineering and management principles while working as team	The learned fundamental concepts of ALU design is useful for working in different areas like academics, research or industry in futur	To find different architectural (H/W and S/W) solutions based on complexity of real world problem.	Use of ALU design knowledge to excel in various project competitions and technological challenges.

	and mathematics								proje ct (if need ed).	n		e.		
C377.2	**2**	**2**	**2**		**3**	**2**			**1**	**2**	**2**	**2**	**2**	**2**
Reasons	Fundamentral concepts of fetching instruction and data using various addressiing mode of 8085	Various problem domain where 8085 asembly can be used.	Development of solutions of problems using 8085 assembly.		Use of java based 8085 simulator to learn and implementation of assembly language.	Application of appropriate microprocessor 8085 will be use to analyze and solve different real-world problems.			Assignments will be assigned to apply concepts of 8085. Moreover, the concept can be used in project (if needed).	8085 concepts can be used as part of project supported with presentation and design document for learning effective communication	The concepts will be used as fundamental to develop the project and understand the engineering and management principles while working as team	The learned fundamental concepts of 8085 design is useful for working in different areas like academics, research or industry in future.	To find different architectural (H/W and S/W) solutions based on complexity of real world problem.	Use of 8085 design knowledge to excel in various project competitions and technological challenges.
C377.3	**2**		**2**		**3**	**2**			**2**	**1**	**2**	**2**	**2**	**2**

Reasons	Fundamental concepts of assembler directives and I/O 8085	Various problem domain where 8085 assembly can be used.	Development of solutions of problems using 8085 assembly.		Use of java based 8085 simulator to learn and implementation of assembly language.	Application of appropriate microprocessor 8085 will be use to analyze and solve different real-world problems.			Assignments will be assigned to apply concepts of 8085. Moreover, the concept can be used in project (if needed).	8085 concepts can be used as part of project supported with presentation and design documentation for learning effective communication	The concepts will be used as fundamental to develop the project and understand the engineering and management principles while working as team	The learned fundamental concepts of basic 8085 is useful for working in different areas in future.	To find different architectural (H/W and S/W) solutions based on complexity of real world problem.	Use of 8085 design knowledge to excel in various project competitions and technological challenges.
C377.4	**2**	**2**	**2**		**3**	**2**			**2**	**2**	**2**	**2**	**2**	**2**
Reasons	Fundamental concepts of assembler drectives and interrupts of MIPS	Different problem domain where MIPS can be used.	Development of solutions of problems using MIPS assembly.		Use of MARS simulator and MIPS assembly language will be taught.	Application of appropriate microprocessor is analyzed different public issues			Assignments will be assigned to apply concepts of MIPS. Moreover, the concept can be used	MIPS concepts can be used as part of project supported with presentation and design docu	The concepts will be used as fundamental to develop the project and understand the engineering and mana	The learned fundamental concepts of MIPS design is useful for working in different areas like	To find different architectural (H/W and S/W) solutions based on co mpl exit	Use of MIPS design knowledge to excel in various project competitions and technological challenges.

								in project (if needed).	ment for learning effective communication	gement principles while working as team	academics, research or industry in future.	y of real world problem.	
C377.5	**3**	**3**	**2**		**3**	**1**			**3**	**3**	**2**	**2**	**2**	**2**
Reasons	Fundamental knowledge of 8085 /MIPS and RISC/CISC architeture based microprocessor / microcontroller for PBL	To understand, anayze the different problem domain and their research challenges using basic concepts learned in of COA lab.	Solution for real-time problems/applications using concepts of microprocessor/ microcontroller such as 8085, arduino or any other controller		Project will be designed using 8085 / 8086 / MIPS/ Other advanced controller (like Arduino) / Small Size computer (like Raspberry Pi)programming either in assembly or high level	The project may select different processors like 8085 / MIPS/ Iot related micro controllers like Arduino and Rasberry Pi to to solve real-world problems			The project will help to grow the students as individual and team	Basic COA concepts are applied as part of project with development of its design document. The work will be presented to improves the effective communication.	The project will help to demonstrate knowledge and understanding of the engineering and management principles while working as team	The project will help to apply the COA concepts and analyze the effectiveness of solution, which is useful for future , in case of exploring this domain in terms of (academics, research	To find different architectural (H/W and S/W) solutions based on complexity of real world problem.	The students will be able to excel in various programming/project competitions and technological challenges laid by professional societies in this domain.

					lang uage .							or indu stry)		
Avg.	2	2	2		3	2			2	2	2	2	2	2

Course Code	15B11CI412	Semester Odd (specify Odd/Even)	Semester V Session 2022-23 Month from July to Dec 2023
Course Name	Operating Systems and Systems Programming		
Credits	4	Contact Hours	3-1-0

Faculty (Names)	Coordinator(s)	Sec 62: Dr. Vikash, Sec 128: Ashish Sharma
	Teacher(s) (Alphabetically)	Sec 62:, Dr Vivek Kumar Singh, Mr. Kashav Ajmera, Dr. Prakash Kumar, Mr. Prashant Kaushik , Dr. Taj Alam, Dr. Ankita Jaiswal
		Sec 128: Dr. Anubhuti, Ambalika, Ashish Sharma

COURSE OUTCOMES		COGNITIVE LEVELS
C311.1	Explain the fundamental concepts along with the various components of operating systems and system programming.	Remember Level (C1)
C311.2	Apply various OS scheduling techniques and algorithms for processes and threads.	Apply Level (C3)
C311.3	Elaborate the various resource management techniques of operating systems and their performance.	Evaluate Level (C5)
C311.4	Omit the concept of IPC and describe various process synchronization techniques in OS.	Understand Level (C2)
C311.5	Compare various disk scheduling algorithms and utilize IO management techniques.	Apply Level (C3)
C311.6	Analyze the appropriate OS design choices when building real-world systems.	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction and Historical context of Operating Systems	What are Operating Systems? All components Description, The Evolution of OS: Batch Systems, multi programming systems, Time sharing systems, Parallel systems, Real Time systems, Distributed systems.	2
2.	Operating Structure and Architecture	Operating system structure: Micro kernel, Monolithic systems, Layered systems, Virtualization, Client-server model, Mobile Operating System. X86 architecture overview, Booting sequences, Boot loaders and their stages, BIOS and its routines, Interrupts.	2
3.	Process Concepts, Threads & Concurrency, Scheduling Concurrency & Synchronization issues,	Process concepts, Threads: Overview, Benefits, User and Kernel threads, Multithreading models. Scheduling, Operations on processes, Cooperative processes, IPC, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Process synchronization: Critical section problems, Semaphores, Synchronization hardware and monitors.	10
4.	Deadlock	System model, Characterization, Methods for handling deadlocks. Deadlock prevention, Avoidance and detection, Recovery from deadlock	5

5.	Memory Management.	Background, Swapping, Contiguous memory allocation, Paging, Segmentation, Segmentation with Paging, Virtual Memory	8
6.	File System management and Input output management	File concept, Access models, Directory structure, Protection, File-system Structure, Allocation methods, Free space management. Overview, I/O hardware, Application I/O interface.	2
7.	Secondary Storage Management	Disk structure, Disk scheduling, Disk management., Swap-space management	2
8.	Fault and Security Issues	Overview of system security, Security methods and devices, Protection, access, and authentication, Models of protection, Memory protection.	2
9.	Distributed O.S	Int. to distributed operating systems, synchronization and deadlock in distributed systems	1
10.	Case studies of OS	Windows, Linux ,IBM, Tizen Operating System	2
11.	System Programming	Introduction, Components of a Programming System: Assemblers, Loaders, Macros, Compliers, Formal System.	2
12.	Interrupts and Exceptions	Synchronous and asynchronous interrupts, Calling a System Call from User Space, INT, Trap Handling, System call dispatch, arguments and return value, Device Interrupts.	2
13.	Kernel Synchronization, System Calls and System Signals	Disabling Interrupts, Lock Implementation, Linux Synchronization Primitives	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance, Quiz/Assignment/Mini Project/Case Study)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	William Stallings, "OPERATING SYSTEMS INTERNALS AND DESIGN PRINCIPLES".
2.	Andrew S. Tanenbaum, "Operating Systems Design and Implementation", Third Edition, Prentice Hall Publications 2006
3.	A.S. Tanenbaum, "Modern Operating Systems", 2nd edition, Prentice Hall India.
4.	A.Silberschatz, P.Galvin, G. Gagne, "Operating systems concepts" Willey international company (sixth edition)
5.	Gary Nutt, "Operating Systems – A modern perspective", Pearson Education
6.	David Solomon and Mark Russinovich ," Inside Microsoft Windows 2000", Third Edition, Micorosoft Press

7.	D. M. Dhamdhere, " Systems Programming and Operating systems" TMH, 2nd revised edition.2006
8.	ACM/IEEE transactions on operating systems concepts.
9.	www.vmware.com
10.	www.luitinfotech.com/kc/what-is-cloud-computing.pdf
11.	https://cs162.eecs.berkeley.edu/static/sections/section8.pdf
12.	Charles Crowley "Operating System A Design Approach" TMH.

Detailed Syllabus
Lab-wise Breakup

Subject Code	15B17CI472	Semester Even (specify Odd/Even)	Semester V Session 2023-2024 Month: July-Dec 2023	
Subject Name	Operating System and System Programming Lab			NBA Code: C275
Credits	0-0-1	Contact Hours	2	

Faculty (Names)	Coordinator(s)	Dr. Vivek Kumar Singh (Sec-62) & Dr. Anubhuti (Sec 128)
	Teacher(s) (Alphabetically)	Dr. Ashish Parihar, Kashav Ajmera, Dr. Parmeet Kaur, Prashant Kaushik, Dr. Vivek Kumar Singh

COURSE OUTCOMES		COGNITIVE LEVELS
C275.1	Demonstration of Various Unix Commands.	Understand Level (Level 2)
C275.2	Develop programs to create different types of processes under Linux environment.	Apply Level (Level 3)
C275.3	Develop programs to implement resource management task like CPU scheduling algorithms, deadlock handling.	Apply Level (Level 3)
C275.4	Develop programs to implement and test various synchronization techniques like semaphores, binary semaphore and monitors via different classical test suites.	Apply Level (Level 3)
C275.5	Examine the various disk-scheduling algorithms, memory management schemes, file management systems.	Analyze Level (Level 4)

Module No.	Topic	No. of Labs	COs
1.	Unix Commands	1	C275.1
2.	Process creation/ Inter process communication (IPC)	1	C275.2
3.	Processes creation using pthread library under Linux environment.	2	C275.2
4.	Synchronization techniques like semaphores, binary semaphore and monitors via different classical test suites.	2	C275.4
5.	Resource management task like CPU scheduling algorithms, deadlock handling.	1	C275.3
6.	Disk-scheduling algorithms, memory management schemes, file management systems.	1	C275.5

Evaluation Criteria

Components	Maximum Marks
Lab Test-1	20
Lab Test-2	20
Day-to-Day	60(Mini Project-20, Lab Assessment-30, Attendance-10)
Total	100

Project Based Learning: Project based learning: Each student works on different case studies in Lab Assignments. They utilize the concepts taught in the lab and develop projects in a group of 3-4. The course emphasized on the skill development for employability in software industry by engaging students on soft development methodologies of operating systems. Various activities are carried out to enhance the student's software development skills. Some of them are study of various scheduling methods, memory management techniques and file management techniques.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc.)	
Text book(s)	
1.	Charles Crowley "Operating System A Design Approach" TMH.
2.	Andrew S. Tanenbaum "Operating Systems Design and Implementation", Third Edition, Prentice Hall Publications 2006
3.	A.S. Tanenbaum, "Modern Operating Systems", 2nd edition, Prentice Hall India.
4.	A.Silberschatz, P.Galvin, G. Gagne, "Operating systems concepts" Willey international company (Ninth edition)
Reference Book(s)	
5.	Gary Nutt, "Operating Systems – A modern perspective", Pearson Education
6.	David Solomon and Mark Russinovich, "Inside Microsoft Windows 2000", Third Edition, Micorosoft Press
7.	Milan Milenkovic, "Operating Systems: Concepts and Design", McGraw-Hill computer science series
8.	ACM/IEEE transactions on operating systems concepts.
9.	www.vmware.com

Detailed Syllabus

Course Code	15B17CI576	Semester Odd (specify Odd/Even)	Semester 5th Session 2023 -2024 Months from July 2023 to December 2023
Course Name	Information Security Lab		
Credits	1	Contact Hours	2

Faculty (Names)	Coordinator(s)	J62:Mradula Sharma J128: Shariq Murtuza
	Teacher(s) (Alphabetically)	J-62: Dr. Amanpreet Kaur,Mradula Sharma, Dr. SharddhaPorwal, Dr. Somya Jain, Dr. Raghu Vamsi J-128: Shariq Murtuza, Dr. Kedar Singh

Course Outcomes (CO)	Description	Cognitive Level (Bloom's Taxonomy)
C374.1	Understand and demonstrate the foundational principles of information security by explaining the concepts of symmetric key cryptography, Data Encryption Standard, and public key cryptography.	Level-2 (Understanding Level)
C374.2	Apply the knowledge of symmetric key cryptography and key exchange algorithms to design and implement secure communication protocols in client-server programming.	Level-3 (Applying Level)
C374.3	Assess and categorize the vulnerabilities in system by inspecting network traffic using Wireshark	Level-4 (Analyzing Level)
C374.4	Compare different steganography, antivirus and anti-worm solutions, assessing their effectiveness in protecting against malware threats.	Level-5 (Evaluating Level)
C374.5	Students will be able to design and implement information security measures for real-world applications.	Level-6 (Creating Level)

Module No.	Title of the Module	List of Experiments
1.	Cryptography	Introduction to Cryptography
2.	Ciphers	Implementation of Cipher using Transposition techniques and Caesar Cipher
3.	Ciphers	Implementation of Substitution Ciphers: Hill Cipher and Polyalphabetic Cipher

4.	Symmetric key cryptography	Introduction to Symmetric key cryptography
5.	Data Encryption Standard	Implementation of Data Encryption Standard (DES)
6.	Public key cryptography	Introduction to Public key cryptography and Digital signature
7.	Key Exchange Algorithm	Implementation of Diffie Hellman Key Exchange Algorithm
8.	Client server programming	Client server programming using TCP
9.	Client server programming	Implementation of DES and RSA using Client server programming
10.	Steganography	Introduction to Steganography
11.	Antivirus and Anti-Worms	Introduction to Antivirus and Anti-Worms, and Wireshark tool
12.	Applications of Information Security	Applications of Information Security to real world problems
13.	Wireshark	Understanding of Secure-socket layer, Application Layer (HTTP, FTP, DNS) using Wireshark tool

Project based learning: The students are grouped into groups of size 5-6 and will be implementing a secure client server program with required encryption techniques. The student will analyze the requirements and select the required solutions. This will help in the employability of students in the information security sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
Textbooks:

1.	Information Security, Principles and Practice, , 2nd Edition, Mark Stamp, Wiley, 2011
2.	Security in Computing 5thEdition , Charles P Fleeger et. al. - Prentice Hall, 2015
Reference Books:	
1.	The InfoSec Handbook: An Introduction to Information Security- Apress Open, Nayak, Umesha, and UmeshHodeghatta Rao, 2014
2.	Information Security: The Complete Reference, 2ndEdition- Mark Rhodes Ousley, 2013
3.	Cracking Codes with Python: An Introduction to Building and Breaking Ciphers-Al Sweigart, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B19CI591	Semester Odd (specify Odd)	Semester V Session 2023- 2024 Month from July to December
Course Name	Minor Project-1		
Credits	2	Contact Hours	4

Faculty (Names)	Coordinator(s)	ANKIT VIDYARTHI, ANUBHUTI MOHINDRA
	Teacher(s) (Alphabetically)	ALL FACULTY

COURSE OUTCOMES		COGNITIVE LEVELS
C350.1	Gather the requirement of the tools, techniques, and programming language constructs to design the solution of the problem	Understanding (Level 2)
C350.2	Choose the best appropriate programming platform, language, tools, and data structure to implement the solution of the problem	Apply (Level 3)
C350.3	Illustrate the linking of the various modules and sub modules of the designed solution with proper demonstration	Analyzing (Level 4)
C350.4	Evaluate results to test the effectiveness of the proposed solution	Evaluating (Level 5)
C350.5	Managing to deploy the project with source code and Database (If prepared) on open source platform like Github and others.	Creating (Level 6)

Evaluation Criteria	
Components	**Maximum Marks**
Viva-1	20
Viva-2	20
D2D	60
Total	**100**

Project-based learning: Each student in a group of 3-4 will have to develop a Minor Project based on different engineering concepts. The students can opt for any real-world application to implement Minor Project. The students have to implement the real-world problem using an open-source programming language. Project development will enhance the knowledge and employability of the students in the IT sector.

Subject Code	16B1NHS432	Semester: ODD	Semester V Session 2023-2024 Months: from July to December	
Subject Name	**POSITIVE PSYCHOLOGY**			
Credits	3	Contact Hours	(3-0-0)	
Faculty (Names)	Coordinator(s)	Dr. Badri Bajaj (JIIT-62) & Dr. Shweta Verma (JIIT-128)		
	Teacher(s) (Alphabetically)	Dr. Badri Bajaj, Dr. Shweta Verma		

	COURSE OUTCOMES	COGNITIVE LEVELS
CO1	Demonstrate an understanding of the various perspectives of positive psychology and apply them in day to day life	Apply Level (C3)
CO2	Examine various theories and models of happiness, well-being and mental health	Analyze Level (C4)
CO3	Recommend possible solutions for enhancing happiness, well-being and mental health	Evaluating Level (C5)
CO4	Evaluate interventions/strategies for overall positive functioning	Evaluating Level (C5)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Positive Psychology	Overview, Perspectives, Classification and Measures: Human Strengths and Positive Outcomes.	**6**
2.	Prosocial Behavior	Empathy and Egotism; Altruism, Gratitude, and Forgiveness.	**6**
3.	Positive Emotions and Wellbeing	Emotional and Cognitive States; Focus on Application: Finding the positive in the Negative; Positive Emotions & Well-Being; Positive Emotions & Flourishing; Flow Experiences	**6**
4.	Happiness	Happiness and its Traditions; Determinants- Subjective Well-Being Hedonic Basis of Happiness; Life Satisfaction; Self –Realization: The Eudaimonic Basis of Happiness Happiness and Emotional Experiences; Other Facts of Life- Work & Unemployment; Intelligence; Education; and Religion.	**6**

5.	Mental Health	Mental Health and Behavior; Prevent the Bad and Enhance the Good.	6
6.	Positive Environments	Positive Schooling, Good at Work, Balance Between ME and WE.	6
7.	Living Well	Mindfulness; Contours of a Positive Life: Meaning & Means; Cultural Context, Every Stage of Life, Resilience, Positive Youth Development, Life Tasks of Adulthood, Successful Aging.	6

Total number of Hours			**42**

Evaluation Criteria		
Components	**Maximum Marks**	
T1	20	
T2	20	
End Semester Examination	35	
TA	25 (Project, Quiz, Attendance)	
Total	**100**	

Project based learning: Students will identify possible solutions for enhancing happiness and well-being. They will work in groups and identify easy to implement solutions having minimal financial bearing on them using these strategies. Existing resources at the home, institution, work organization, and community can be used. While identifying the strategies it is essential to refer to various research papers, books, and online resources, etc. to support the logic behind the identified strategies. Each student will implement the identified strategies for minimum three weeks and share their experiences before and after implementation. Each group will submit a project report after completion of the project. It will be important to add appropriate references (in-text citations and bibliography) for identifies strategies in the report.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Snyder, C.R., Lopez, S. J., & Pedrotti, J.T. *Positive Psychology: The Scientific and Practical Explorations of Human Strengths*, 4th Ed., Sage Publications, 2018.
2	Steve, B., & Marie, C. *Positive psychology*, 1st Ed., Pearson Education India, 2014.
3.	Boniwell, I., & Tunariu, A. D., *Positive Psychology: Theory, Research and Applications*, 2nd Ed., McGraw-Hill Education, 2019.
4.	Zelenski, J., *Positive Psychology: The Science of Well-being*, 1st Ed., Sage Publications, 2019.
5.	Snyder, C. R., Lopez, S. J., Edwards, L. M., & Marques, S. C. (Eds.), *The Oxford handbook of positive psychology*. 1st Ed., Oxford university press, 2020.

.

Course Code	**16B1NHS433**	Semester: Odd	Semester: Session 2023-2024
			Month from: July to Dec

Course Name	Financial Management

Credits	3	**Contact Hours**	3 (3-0-0)

Faculty (Names)	**Coordinator(s)**	Dr Mukta Mani, Dr. Sakshi Varshney
	Teacher(s) (Alphabetically)	Dr Mukta Mani, Dr. Sakshi Varshney

COURSE OUTCOMES		COGNITIVE LEVELS
C303-3.1	Understand the fundamental concepts of Financial Management and its various dimensions	Understand (Level 2)
C303-3.2	Apply the knowledge of the time value of money, capital budgeting techniques, cost of capital and in taking long-term investment decisions	Apply (Level 3)
C303-3.3	Analyze the leverage capacity of a business and apply it in the selection of Long-term sources of finance.	Analyze (Level 4)
C303-3.4	Evaluate the financial performance of a business through financial statements	Evaluate (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Basic financial concepts-Meaning of Accounting, Accounting Concepts and Conventions, Introduction to Double Entry system and Accounting equation, Definition and Objectives of Financial management,	4
2.	Time value of Money	Compounding, Discounting, Annuity, Perpetuity, Loan Amortization	5
3.	Analysis of Financial Statements	Understanding of Balance Sheet and Income Statements, Ratio Analysis, Interpretation, Importance and limitations	5
4.	Capital Budgeting: Principle Techniques	Nature of Capital Budgeting, Evaluation Techniques: Discounting (NPV, IRR etc.) and Non-discounting Techniques (payback, ARR etc)	6
5.	Long Term Sources of Finance	Definition, types, advantages and disadvantages	4
6.	Concept and measurement of cost of capital	Definition, measurement of specific costs, computation of Overall Cost of Capital,	5
7.	Cash Flows for Capital Budgeting	Identification and determination of relevant cash flows	5
8.	Leverages and Capital Structure Decision and Working Capital Management	Break Even Analysis, Operating, Financial and combined leverage, Capital structure EBIT- EPS analysis, Concept of working capital management, practical considerations in Working capital management, Evils of Excess or Inadequate Working Capital, Cash Management – Receivables Management – Inventory Management	8
		Total number of Lectures	**42**

Evaluation Criteria	**Maximum Marks**

Components	20
T1	20
T2	35
End Semester Examination	25 (Project+ Quiz+ Class participation)
TA	**100**
Total	

Project-based learning: Each student in a group of 4-5 will opt for a company which is listed in at least one of the stock exchanges of India. To make the subject application based, the students analyze the latest financial data and other information of the last two years of the chosen company by the financial tool of Ratio analysis and use this financial data for decision-making. Understanding the Balance Sheet and financial statements of the business firm enhances the student's knowledge of the organisational structure of the firm and financial analysis helps their employability in the financial sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Chandra, P., *Financial Management Theory and Practice*,11th ed., Tata McGraw Hill, 2022.
2.	Horne, J.C.V. and Wachowicz, J.M. Fundamentals of Financial Management, 13th ed., Pearson Publication, 2009. Accessed online: https://wps.pearsoned.co.uk/ema_uk_he_wachowicz_fundfinm an_13/106/27149/6950308.cw/-/6950310/index.html
3.	Khan, M.Y. and Jain, P.K. Financial Management: Text, Problems and Cases, 8th ed., McGraw Hill Education, 2020.
4.	Kishore, R.M., *Financial Management*, 8th ed, Taxmann, 2020
5.	Mukherjee,M and Hanif.M., Financial Accounting, 8th ed., Tata McGraw Hill,2008.
6.	Pandey, I.M., Financial management, 12th ed, Vikas Publishing House Pvt Ltd, 2021

Subject Code	16B1NHS434	Semester: ODD	Semester V Session 2023-24 July - December
Subject Name	**Introduction to Contemporary Form of Literature**		
Credits	3	**Contact Hours**	**3 (3-0-0)**

Faculty (Names)	Coordinator(s)	**Dr Monali Bhattacharya (Sector 62)**
	Teacher(s) (Alphabetically)	**Dr Monali Bhattacharya**

Course Outcomes:

	Course Outcome	**COGNITIVE LEVELS**
C303-6.1	Interpret & relate with the genres, periods, and conventional as well as experimental forms of literature.	CL-2 Understand
C303-6.2	Apply literary and linguistic theories on the texts to identify them as cultural constructs.	CL-3 Apply
C303-6.3	Analyze select representative texts of different cultures thematically and stylistically.	CL-4 Analyse
C303-6.4	Evaluate literature as reflection of society through a research-based paper/poster presentation individually and / or in a team.	CL-5 Evaluate
C303-6.5	Create literary, non-literary write-up with proper applied grammar usage.	CL-6 Create

.

Module No.	Subtitle of the Module	Topics in the module	No. of Hours for the module
1.	**Introducing Literary Theories**	• From Formalism to Reader Response Theory: Major Terms & Concepts • Narrative Art & Narratology • Language & Style: An Introduction	12
2.	**Introducing New Forms & Sub Genres Today: Features & Portions**	• New Fiction: Graphic Novels, Cyberpunk • Non-Fiction: Memoirs & Autobiographies, Biographies	4

3.	**Modern Retellings/ Childeren's Literature**	*Cinderella* (Poem) - Roald Dahl	3
4.	**European Lit./Travel/ Memoir/ Spiritual Literature**	*Eat, Pray & Love (Travelogue& cinematic adaptation)*	4
5.	**Written Communication Through Non-Fiction**	*Personal Narratives (Diary, Blog, Memoirs, Travelogue)*	4
6.	**Commonwealth / Indian Literature**	*Hayavadana (Short Play)*- Girish Karnad	4
7.	**Afro-American Lit/ Post Colonial Literature**	*Sweetness (Short Story)* – Toni Morrison	3
8	**Sci-fi (Cyberpunk)**	*Neuromancer (Science Fiction) – William Gibson*	4
9	**Canadian Literature/ Speculative Fiction**	*The Penelopiad- Margaret Atwood*	4
		Total number of Hours	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Quiz, Project, Class Interaction)
Total	**100**

PBL Component: Project: The project is to be submitted in two parts, a Digital Poster and a report.
It is to be done in a group of 5-6 students.
Project : Comparative Analysis of any text with Penelopiad or Hayavadana in Digital Poster Format through application of theories & Report on the analysis and team effort.
 Poster is to be made in comparative mode in narrative format (as per sample shared) using archetypal symbols & by applying formalism and reader-response theory to analyze its contemporary significance.
Report is to be made in 2-3 pages.
Students would take a text (Novel /play/adaption) of their choice which is based on some of the myths of East or West, but it should not be any of the texts taught in V Semester syllabus of this course to compare it with Penelopiad or Hayavadana.

Recommended Reading material:

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	M.H. Abrams, 'A Glossary of Literary Terms'.7th Edition, Hienle&Hienle: Thomson Learning, USA, 1999. For online version: https://mthoyibi.files.wordpress.com/2011/05/a-glossary-of-literary-terms-7th-ed_m-h-abrams-1999.pdf

2.	Mark William Roche, 'Why Literature matters in the 21st Century', 1st Edition, Yale University Press, 2004.
3	https://allpoetry.com/poem/8503199-Cinderella-by-Roald-Dahl Online video version: https://www.youtube.com/watch?v=dLmNG5EbHvc. An interview with Dahl: https://www.youtube.com/watch?v=pA7kUPStmPE
4	Elizabeth Gilbert, 'Eat, Pray & Love. 1st Edition, Penguin,US, 2006. For online version: http://mrs-sullivan.com/wp-content/uploads/Eat-Pray-Love-Book-on-pdf.pdf An interview with Elizabeth : https://www.youtube.com/watch?v=m9B9zFo4RFw
5	William Zinsser, 'On Writing Well: The Classic Guide to Writing Nonfiction', Harper Perennial; 30th Anniversary ed. Edition, 2016 For Online version: http://richardcolby.net/writ2000/wp-content/uploads/2017/09/On-Writing-Well-30th-Anniversa-Zinsser-William.pdf
6	Girish Karnad, 'Hayavadana', 1st Edition, Oxford University Press, Delhi, 1975 (30th Impression, 2012). For online version: https://pdfcoffee.com/hayavadana-girish-karnadpdf-pdf-free.html An interview with Karnad: https://www.youtube.com/watch?v=laL7oWWuLGI
7	https://www.newyorker.com/magazine/2015/02/09/sweetness-2 Audio version: https://www.youtube.com/watch?v=ltKXTZTBmPs. An interview with Morrison: https://www.youtube.com/watch?v=DQ0mMjII22I&list=RDDQ0mMjII22I&start_radio=1&rv=DQ0mMjII22I&t=107
8	William Gibson, 'Neuromancer', 1st Edition, The Berkley Publishing Group, New York, 1984. For online version http://index-of.es/Varios-2/Neuromancer.pdf
9	Margaret Atwood, 'The Penelopiad', 1st Edition, Canongate Series, Knopf, Canada, 2005. For online version: https://www.langhamtheatre.ca/wp- content/uploads/2010/09/The-Penelopiad.pdf An interview with Atwood: https://www.youtube.com/watch?v=D5Wj_JQ6NhY

CO-PO and CO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	BT PSO1	PSO2	PSO3	CSE PSO1	PSO2	ECE PSO1	PSO2	IT PSO1	PSO2
C303-6.1									1	3		3									
C303-6.2						2			1	3		3									
C303-6.3						2		2	1	3		3									
C303-6.4						2		2	3	3		3									
C303-6.5									3	3		3									
AVG						2		2	2	3		3									

Syllabus and Evaluation Scheme of Planning and Economic Development

CourseCode	16B1NHS532	Semester: ODD (specify Odd/Even)	Semester: 5ᵗʰ Month: from July to Dec. 2023
CourseName	Planning and Economic Development		
Credits	03	ContactHours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Amba Agarwal Dr. Amandeep Kaur
	Teacher(s) (Alphabetically)	Dr. Amba Agarwal Dr. Amandeep Kaur

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Understand the issues and approaches to economic development.	Understand (Level 2)
CO2	Apply an analytical framework to understand the structural characteristics of development.	Apply (Level 3)
CO3	Analyze the role of Macroeconomic stability & policies and Inflation in the development process.	Analyze (Level 4)
CO4	Examine the importance of federal development and decentralization.	Analyze (Level 4))
CO5	Evaluate National income accounting, human development index and sustainable development.	Evaluate (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Economic Development and its Determinants	Economic growth and development. Indicators of development. Approaches to economic development. Rostows Stages of Growth.	5
2.	National Income Accounting	National Income Accounting, Green GNP and Sustainable development	5
3.	Indicators of development	PQLI, Human Development Index (HDI) and gender development indices.	4
4.	Demographic Features, Poverty and Inequality	Demographic features of Indian population; Rural-urban migration; Growth of Primary, Secondary and Tertiary Sector.	5
5.	Inflation and Business Cycles	Inflation. Business cycle. Multiplier and Accelerator Interaction.	6
6.	Macro-Economic Stability & Policies	Monetary Policy. Fiscal Policy. Role of Central Bank & Commercial banks in the development of the country. Balance of payments; currency convertibility and Issues in export-import policy.	6
7.	Federal	The Federal Set-up - The Financial Issues in a	6

	Development	Federal Set-up, Principles for Efficient Division of Financial Resources between Governments. Financial Federalism under Constitution. Finance Commissions in India, Terms of References and its Recommendations	
8.	Planning and Development	Need for planning, Decentralisation, Rural and Urban local bodies.	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment + Quiz)
Total	**100**

Project-based Learning: Each student in a group of 4-5 will opt a topic and submit a report related to India's Development Indicators based on following parameters; National Income, State Income, Human Development Index (HDI), Gender Development Indices (GDI), Demographic Profile, Migration, Sectoral contributions of income and employment, Poverty, Income Inequality & literacy, Federal Structure, Budgetary estimates, Tax and Monetary Policy, Distribution of financial resources from central to state to local bodies. Understanding fundamental development indicators will upgrade student's knowledge on various Economic Development front and improve mechanism to formulate suitable policy design, which further strengthen their employability into public and private decision-making body.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Todaro, M.P.**, **Stephen C. Smith,** Economic Development, Pearson Education, 2017
2.	**Thirwal, A.P**., Economics of Development, Palgrave, 2011
3.	**Ahuja, H. L.**, Development Economics, S Chand publishing, 2016
4.	**Ray, Debraj,** Development Economics, Oxford University Press, 2016
5.	**Meier, G.M.,** Leading Issues in Economic Development, Oxford University Press, New Delhi, 2008
6.	**Ahuja, H. L.,** Development Economics, S Chand publishing, 2016
7.	**Benavot, Aaron.** "Education, gender, and economic development: A cross-national study." Sociology of education (1989): 14-32.
8.	**Falk, Armin, and Johannes Hermle.** "Relationship of gender differences in preferences to economic development and gender equality." Science 362, no. 6412 (2018).

Theory of Numbers (16B1NMA731)

Divisibility, The greatest common divisor, coprime integers, The least common multiple, Linear Diophantine Equations, The Fundamental Theorem of Arithmetic, Prime Number Theorem, Goldbach and Twin Primes conjectures, Residue classes, Euclid's algorithm, Chinese Remainder, Wilson's and Fermat's Theorem, pseudoprimes. Greatest integer function, The Euler phi function, RSA Cyptosystem, arithmetic function, The Mobius function, Carmichael conjecture, The number-of-divisors and sum-of-divisors functions, Perfect numbers, characterization of even perfect numbers. Quadratic residues and non-residues, The Legendre symbol, Euler's Criterion, The law of quadratic reciprocity. Primitive roots.

Course Description

Course Code	16B1NMA731	**Semester** Odd	**B.Tech.** V **Semester Session Month from July 2023 to Dec. 2023**	
Course Name	Theory of Numbers			
Credits	3		**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Himanshu Agarwal		
	Teacher(s) (Alphabetically)	Dr. Himanshu Agarwal		

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C301-4.1	explain concepts related to divisibility, congruences, numbers of special form, number theoretic functions, primitive roots and indices.	Understanding (C2)
C301-4.2	solve the system of linear congruences using properties of congruences, Euclid algorithm and Chinese remainder theorem.	Applying (C3)
C301-4.3	apply the concepts of primitive roots, indices, Legendre symbol and quadratic residue to solve the nonlinear congruences.	Applying (C3)
C301-4.4	analyze the concepts of number theory in hashing, cryptography, calendar and ISBN check digits problems.	Analyzing (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Divisibility and Primes**	Division algorithm, Greatest common divisor, Euclid's algorithm, gcd as a linear combination of coprime integers, Linear Diophantine equations, primes, The fundamental theorem of arithmetic, The Sieve of Eratosthenes, Canonical prime factorization, Least common multiple, Prime number theorem(statement only), Goldbach and twin primes conjectures.	5
2	**Theory of Congruences**	Definitions and basic properties, Residue classes, complete residue systems, reduced residue systems, Linear congruences in one variable, Simultaneous linear congruences, Chinese remainder theorem and its applications, Linear congruences in more than one variable, Fermat's theorem, Pseudoprimes and carmichael numbers, Wilson's Theorem	4
3.	**Number Theoretic Functions and Numbers of Special Form**	Greatest integer function, The number-of-divisors function, The sum-of-divisors function, Multiplicative function, The Mobius function, Mobius inversion formula, The Euler's totient function, Euler's theorem, Perfect numbers, characterization of even perfect numbers, Mersenne primes, Fermat primes	8
4.	**Primitive Roots and Indices**	The order of an integer, Primitive roots, Theory of indicies, Solution of non-linear congruences.	9
5.	**Quadratic Residues**	Quadratic residues and non-residues, Euler's Criterion, The Legendre symbol, Gauss Lemma, Quadratic reciprocity, Solution of quadratic congruences.	8
6.	**Applications**	Hashing functions, Cyptosystem, Calendar problem, ISBN check digits	8
		Total Number of Lectures	**42**

Evaluation Criteria
Components Maximum Marks T1 20 T2 20 End Semester Examination 35 TA 25 (Quiz, Assignments, Tutorials, PBL) **Total 100**

<mark>Project based learning: Each student in a group of 4-5 will analyse applications of Chinese remainder theorem in congruency problems. Also the students will explore the applications of secure communication techniques, Cyptosystem, Calendar problem, ISBN check digits.</mark>

	Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)
1.	**James Strayer**, Elementary Number Theory, Waveland Press, 1994/2002, ISBN 1-57766-224-5.
2.	**Kenneth Rosen**, Elementary Number Theory and its Applications, 5th Edition, McGraw Hill, ISBN 0-201-87073-8.
3.	**I. Niven, H. Zuckerman, H. Montgomery**, An Introduction to the Theory of Numbers, 5th Edition, Wiley, ISBN 0471625469.
4.	**David M. Burton**, Elementary Number Theory, 7th Edition, McGraw Hill Education (India) Private Limited.

CO-PO and CO-PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1 (CSE)	PSO1 (IT)	PSO1 (ECE)	PSO2
C301-4.1	2	2	2	1								2				
C301-4.2	3	3	2	2								2				
C301-4.3	3	3	2	2								2				
C301-4.4	3	3	3	2					1			2	1	1	1	
Avg.	**2.8**	**2.8**	**2.3**	**1.8**					**1**			**2**	**1**	**1**	**1**	

Course Code	16B1NPH532	Semester: ODD	Semester: 5th Session: 2022 -2023
			Month from July 22 to December 22
Course Name	Materials Science		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Vikas Malik and Dr Ashish Bhatanagar
	Teacher(s) (Alphabetically)	Dr. Vikas Malik and Dr Ashish Bhatanagar

COURSE OUTCOMES		COGNITIVE LEVELS
C301-11.1	Recall variety of engineering materials for their applications in contemporary devices	Remembering (C1)
C301-11.2	Explain dielectric, optical, magnetic, superconducting, polymer and thermoelectric properties	Understanding (C2)
C301-11.3	Apply properties of dielectric, optical, magnetic, superconducting, polymer and thermoelectric materials to solve related problems	Applying (C3)
C301-11.5	Prove and estimate solution of numerical problems using physical and mathematical concepts involved with various materials	Evaluating (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Dielectric Materials	Polarization mechanism & Dielectric Constant, Behavior of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, Ferroelectrics, Piezoelectric effect; Applications of Dielectric Materials	10
2.	Optical Materials	Basic Concepts, Light interactions with solids, Optical properties of nonmetals: refraction, reflection, absorption, Beer-Lambert law, transmission, Photoconductivity. Drude Model, relation between refractive index and relative dielectric constant, Optical absorption in metals, insulators and semiconductors. Introduction to Photonic band gap (PBG) materials and its applications	6
3.	Magnetic Materials	Concept of magnetism, Classification – dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Their properties and Applications; Hysteresis; Magnetic Storage and Surfaces.	10
4.	Super conducting Materials	Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; BCS Theory, High temperature Superconductors and their Applications	5
5.	Polymers and Ceramics	Various types of Polymers and their applications; Mechanical behavior of Polymers, synthesis of polymers; Structure, Types, Properties and Applications of Ceramics; Mechanical behavior and Processing of Ceramics.	6
6.	Thermoelectric	Thermoelectric (TE) effects and coefficients (Seebeck, Peltier, Thompson); TE materials and devices, Heat conduction,	3

	Materials	Cooling, Figure of Merit; TE power generation (efficiency), refrigeration (COP), Examples and applications.	
		Total number of Lectures	**40**

Evaluation Criteria

Components	Maximum Marks	
T1	20	
T2	20	
End Semester Examination	35	
TA	25 [Quiz/class test (7), attendance (7), PBL assignment (6) and teacher assessment (5)]	
Total	**100**	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	S.O. Pillai, Solid State Physics, New Age International Publishers.
2.	B. B. Laud, Laser and Non-linear Optics, John Wiley & Sons
3.	Van Vlack, Elements of Material Science and Engineering, Pearson Education.
4.	Srivastava and Srinivasan, Material Science and Engineering,
5	W.D. Callister Jr., Material Science and Engineering: An Introduction, John Wiley.

Project Based Learning: Students will make application oriented individual projects on selected material (dielectric, magnetic, superconducting,optical and Thermoelectric etc.) depending on its suitability for advanced application such as medical diagnostic, sensing (pertaining to current pandemic situation) and similar. Each project will envisage the material properties, the working principles, advantages and disadvantages of that specific material as well as the possible advancement from the literature. This will be a group project and students will work in a group of 3-4 students. This project will make them prepared for industry jobs in the material industry or for higher studies in similar fields.

Course Code	20B12CS331	Semester : Odd	Semester 5th Session 2023-2024
			Month: July 2023 to Dec 2023
Course Name	Fundamentals of Machine Learning		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dharamveer Rajpoot (62), Hmani Bansal (128)
	Teacher(s) (Alphabetically)	Anil Kumar Mehto, Dharamveer Rajpoot, Hmani Bansal

COURSE OUTCOMES		COGNITIVE LEVELS
C330-1.1	Understand the mathematical concepts of machine learning approaches.	Understand (Level 2)
C330-1.2	Apply the fundamentals of linear algebra and probability theory to the machine learning problems.	Apply (Level 3)
C330-1.3	Apply the concepts of regression analysis and vector calculus to the machine learning models.	Apply (Level 3)
C330-1.4	Analyze the role of dimensionality reduction and density estimation for machine learning problems	Analyze (Level 4)
C330-1.5	Evaluate and test the significance of machine learning results statistically.	Evaluate (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Machine learning	Why machine learning, learning problems, types of learning: supervised, unsupervised, semi-supervised learning, fundamentals of machine learning	02
2.	Linear Algebra	Linear equations, solving linear equations, matrices, Cholesky Decomposition, singular value decomposition, matrix approximation, vector space, Norms, inner product, length and distances, angles and orthogonality, orthogonal complement, inner product, orthogonal projections and rotations, linear independence, linear mapping, Affine spaces	09
3.	Probability Theory	Discrete and continuous probability, sum rule, product rule, Baye's Theorem, Gaussian Estimation, conjugacy and exponential family, inverse transform, Hidden Markov model	05
4.	Regression Analysis	Problem formulation, parameter estimation, linear regression vs non-linear regression models, univariate vs multivariate regression, regression using least squares, logistic regression in machine learning	05

5.	Vector Calculus	Gradients of vector valued function, gradient descent learning, lagrange's function in supervised learning, automatic differentiation, linearization and multivariate taylor series in machine learning	07
6.	Dimensionality Reduction and Density Estimation	Maximum variance, Low rank approximation, PCA, ICA, LDA, latent Variable, GMM, Maximum Likelihood estimation, expected maximization machine learning	08
7.	Statistical Validations	T test, paired T test, Z test, hypothesis testing, ANOVA, Pearson coefficient, significance testing	06
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks	
T1	**20**	
T2	**20**	
End Term	**35**	
TA	**25**	Attendance (10), Assignment/Quiz/Mini-Project (15)
Total	**100**	

Project based learning: Each student in a group of 3-4 will have to develop a mini project based on fundamentals of machine learning algorithms. The students can opt any real-world application where these algorithms can be applied. The students have to implement the mini project using any open source programming language. Project development will enhance knowledge and employability of the students in IT sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text Books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Text Book(s):

1.	Goodfellow, Ian, YoshuaBengio, and Aaron Courville. (2016). Deep learning. MIT press.
2.	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong. (2020). Mathematics for machine learning. Cambridge University Press.

Reference Book(s):

1.	Mitchell, Tom M. (1997). Machine learning.
2.	Bishop, Christopher M. (2006). Pattern recognition and machine learning. Springer.
3.	Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. (2009). The elements of statistical learning: data mining, inference, and prediction. Springer Science & Business Media.

Course Description

Subject Code	20B12CS332	Semester: Odd	Semester 5th Session 2023 -2024
			Month from: July to Dec 2023
Subject Name	Fundamentals of Computer Security		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr.Charu Gandhi(128), Dr.Asmita Yadav(62)
	Teacher(s) (Alphabetically)	Dr.Charu Gandhi(128), Dr. Asmita Yadav(62), Dr.Amanpreet Kaur(62)

COURSE OUTCOMES		COGNITIVE LEVELS
C330-2.1	Explain the fundamental concepts of computer security, malicious code and its effects	Understand Level (C2)
C330-2.2	Describe various authentication and access control paradigms	Understand Level (C2)
C330-2.3	Apply various preventive measures and techniques used to obtain secure system	Apply Level (C3)
C330-2.4	Examine various security parameters from the perspective of legal and ethical issues	Analyse Level (C4)

Module No.	Subtitle of the Module	Topics in the Module	No. of Lectures for the module
1.	Security Basics	General overview, terminology and definitions, Security policy issues	6
2.	Introduction to Malware	Introduction to Malicious code, Spyware, Ransomware, Logic Bombs, Virus, Bacteria and Worms, Introduction to Anti-malware technology	6
3.	Threats to Network Communications and Basic Cryptography	Threats to Network Communications, Interception: Eavesdropping and Wiretapping, Modification, Fabrication: Data Corruption, Interruption: Loss of Service, Port Scanning, Introduction to cryptography and classical cryptosystem, Steganography vs Cryptography	8
4.	Authentication	Identification Versus Authentication, Authentication Based on Something You Know, Something You Are, Something You Have, Federated Identity Management, Multifactor Authentication, Secure Authentication, Password policies	5
5.	Access Control	Access Policies, Implementing Access Control, Procedure-Oriented Access Control, Role-Based Access Control, Captchas	5

6.	Intrusion Detection and Response	Goals for Intrusion Detection Systems, Types of IDSs – Anomaly Based and Signature Based	5
7.	Firewalls	What Is a Firewall?, Design of Firewalls, Types of Firewalls, Personal Firewalls, Comparison of Firewall Types, Example Firewall Configurations	3
8.	Legal and Ethical Issues	Introduction to Cyber Crimes and Cyber Laws and IT Act 2000	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (**Attendance- 10, Class Test/ Quiz-10, Mini Project (for PBL) -5**)
Total	**100**

Project Based Learning: Each student in a group of 2-4 will choose one of the computer security aspects such as malware defence, cryptographic applications, reverse engineering code, authentication implementation, intrusion detection system development, firewalls configuration etc. for development and analysis. Applyingtheseconceptswill enable the students in enhancing their understanding and skills towards computer system hardening.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

	Text Books:
1.	Security in Computing (5th edition), Pfleeger, Pfleeger and Margulies, Pearson.
2.	Computer Security: Art and Science by Matt Bishop, Addison-Wesley Educational Publishers Inc
	Reference Books:
1.	Computer Security Fundamentals, (4th Edition), Chuck Easttum, Pearson Ed.
2.	Foundations of Computer Security, David Salomon, Springer
3.	Introduction to Modern Cryptography (2nd edition), Katz and Lindell, Chapman & Hall/CRC
4.	Elements of Computer Security, David Salomon, Springer
5.	Cryptography Theory and Practice (3rd edition), Stinson, Chapman & Hall/CRC

Detailed Syllabus
Lecture-wise Breakup

Course Code	20B12CS333	Semester: ODD	Semester: 5th Session:2023 -2024
			Month from July 2023 - December 2023

Course Name	Introduction to Big Data and Data Analytics

Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Pawan Kumar Upadhyay (62), Dr.Neeraj Jain (128)
	Teacher(s) (Alphabetically)	Dr. Pawan Kumar Upadhyay, Dr.Neeraj Jain

COURSE OUTCOMES		COGNITIVE LEVELS
C330-3.1	To demonstrate the fundamental concepts of growing field of big data analytics.	Understand (Level 2)
C330-3.2	To make use of tools required to manage and analyze big data like Hadoop, NoSql MapReduce.	Apply (Level 3)
C330-3.3	To apply predictive models and advanced computing paradigms for big data analytics.	Apply (Level 3)
C330-3.4	To analyze the big data using intelligent & visualization techniques.	Analyze (Level 4)
C330-3.5	To design and create predictive and mathematical model to solve complex real-world problems for decision making.	Create (Level 6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Big Data	Introduction to Big Data landscape, Big Data: Why and where, Characteristics of Big Data- V's of Big Data (volume, velocity, variety, veracity, valence, and value)and Dimensions of Scalability, Data Models for Big Data Products(NOSQL, NEWSQL,HADOOP), Data Science and Analytics.	7
2.	Data Visualization Techniques	Introduction to Python or R, Understanding and Visualizing Data, Data Visualization R/Python.	5
3.	Data Modeling and Optimization	Modeling Uncertainty and Risk, Optimization and Modeling Simultaneous Decisions, Case Study.	5
4.	Decision Making and Predictive Analytics-1	Data exploration, Evaluation methods, Regression Techniques (Linear, Logistics, Multivariate), Classification Techniques (Decision Tree, ID3, Naïve Bayes), Case Study.	9
5.	Decision Making and Predictive Analytics-2	Clustering Techniques, Anomaly Detection, Dimensionality Reduction, Neural networks for deep learning, Hands-on using Python/R, Case Study.	9
6.	Big Data Technologies	Using Hadoop to store data (HDFS, HBASE), Process Data using MapReduce, Testing and Debugging MapReduce Applications.	7
		Total number of Lectures	42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Internal assessment-05, Class Test/Quiz/Assignment-10, Mini-Project in PBL mode-10)
Total	**100**

Project based learning: The number of students in mini-project will be between 2-3. Students will use Python to design, develop, and implement big data applications or predictive models.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Reference Books:

1.	Dey, N., Hassanien, A. E., Bhatt, C., Ashour, A., & Satapathy, S. C. (Eds.). (2018). Internet of things and big data analytics toward next-generation intelligence (pp. 3-549). Berlin: Springer.
2.	Marz, N., & Warren, J. (2015). Big Data: Principles and best practices of scalable realtime data systems. Manning Publications Co.
3.	Grover, M., Malaska, T., Seidman, J., & Shapira, G. (2015). Hadoop Application Architectures: Designing Real-World Big Data Applications. " O'Reilly Media, Inc.".
4.	Covington, D. (2016). Analytics: Data Science, Data Analysis, and Predictive Analytics for Business. CreateSpace Independent Publishing Platform.

Text Books:

1.	EMC Education Services. (2015). Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley.
2.	Nelli, F. (2018). Python data analytics: with pandas, numpy, and matplotlib. Apress.
3.	Sedkaoui, S. (2018). Data analytics and big data. John Wiley & Sons.
4.	Erl, T., Khattak, W., & Buhler, P. (2016). Big data fundamentals: concepts, drivers & techniques. Prentice Hall Press.
5.	Dasgupta, N. (2018). Practical big data analytics: Hands-on techniques to implement enterprise analytics and machine learning using Hadoop, Spark, NoSQL and R. Packt Publishing Ltd.
6.	Kumar, V. N., & Shindgikar, P. (2018). Modern Big Data processing with Hadoop: Expert techniques for architecting end-to-end Big Data solutions to get valuable insights. Packt Publishing Ltd.

Course Code	20B12CS334	Semester ODD	Semester: 5ᵗʰ Session: 2023 - 2024
			Month from: July **to** Dec 2023
Course Name	Object Oriented Analysis and Design Using JAVA		
Credits	3-0-0	**Contact Hours**	3

Faculty (Names)	Coordinator(s)	Dr. Raju Pal (J128) and Shivendra Singh (J62)
	Teacher(s) (Alphabetically)	Dr. Raju Pal (J128) and Shivendra Singh (J62)

COURSE OUTCOMES		COGNITIVE LEVELS
C333-1.1	Explain Object-Oriented Analysis and Design principles	Understand Level (C2)
C333-1.2	Analyze requirements to identify use cases, classes, and objects	Analyze Level (C4)
C333-1.3	Create UML diagrams for structural and behavioral modeling	Apply Level (C3)
C333-1.4	Design and implement software solutions using object-oriented analysis and design	Apply Level (C3)
C333-1.5	Evaluate software design complexity using metrics	Evaluate Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Principles of Object-Oriented Analysis and Design	Programming Paradigms, Introduction to Object Oriented Paradigm, Principles of Object Orientation, Software Complexity: development process, flexibility, behaviour of discrete system, The canonical Form of the complex system, Benefits and Understanding the challenges OOAD can address, Overview of Software Development Life Cycle (SDLC), Object-Oriented Requirements Elicitation & Analysis and Systems Behavior, Quality Attributes	5
2.	Object Oriented Analysis	Identifying Classes and Objects, Responsibilities, Relationships in problem domain, Object Model, Methods of Class Identification, Listing nouns and Verbs, Synonyms, Attributes and Methods Quality Check: Coupling, chohesion, sufficiency, completeness, premitiveness,	8

3.	Structural modeling and its implementation in JAVA	UML structure: Overview of static and dynamic UML diagrams, Modeling System Behavior with use case diagram and notations, From Use Cases to Functional Requirements, Elements of object and class diagram with notations: object, class, link, association, multiplicity, link attributes, association end names, association classes, qualified association, association ends, N-ray association, aggregation and composition, generalization, abstract class. Objects and Classes in JAVA, implementing various relationships in JAVA- Association, Inheritance, generalization, Abstraction in Java, Method Overriding and Overloading, Object Roles, Class Types, Implementing Polymorphism, Extensibility and UML, Generalization with Interfaces and Packages in Java	15
4.	Behavioral modeling	Sequence & Collaboration diagram with notations, Object Collaborations, Interaction Diagrams, State Diagram - Event ,Change Event, Signal Event, Call Event, Time Event , States, Transition & Conditions, Transition, Guard Condition, Action, State Diagrams, One shot State Diagram, Creating State Diagram, State Diagram Behavior, Activity, Do-activity, Entry Activity, Exit Activity, Nested State Diagram, Nested States, Signal Generalization, Concurrency, Activity and Swim lane diagram	4
5.	Design Principles	SOLID principles, Cohesion, Coupling, techniques for good Object-Oriented design, separation of concerns, information hiding, and conceptual integrity	6
6.	OO Design Metrics	Understanding and Analyzing Software Design Metrics for Object Oriented Software.	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [Attendance (10) + Assignment/Quiz/Mini-project (15)]
Total	**100**

Project based learning: Each group of 3-4 students will work on a mini-project. They will identify a real-life problem and develop a solution using their knowledge of the object-oriented approach. The project implementation should preferably be in JAVA and should be accompanied by comprehensive documentation covering various aspects of the software. This approach enhances students' understanding of different object-oriented concepts and prepares them for practical applications in the workforce.

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
Text Books:	
1.	Object Oriented Modeling And Design With UML 2nd Edition by MICHAEL BLAHA and JAMES RUMBAUGH, PEARSON INDIA 2013
2.	UML 2 AND THE UNIFIED PROCESS: Practical Object-oriented Analysis and Design 2nd Editon by Jim Arlow, Pearson 2015
3.	The Object-Oriented Thought Process: ObjectOr Thought Process by Matt Weisfeld 2013
4.	Java: The Complete Reference, Eleventh Edition by Herbert Schildt , 2019
5.	Core Java Volume I--Fundamentals (Core Series) 11th Edition, by Cay S. Horstmann, 2018
Reference Books:	
1.	Head First Object-Oriented Analysis and Design A Brain Friendly Guide to OOA&D By Brett McLaughlin, Gary Pollice, David West 2011
2.	An Introduction to Programming and Object-Oriented Design with Java by Frederick A. Hosch Jaime Nino 2009
3.	OBJECT-ORIENTED ANALYSIS AND DESIGN With applications Third EDITION Grady Booch Rational Santa Clara, California 2009
4.	Object Oriented Analysis and Design Andrew Haigh 2001
5.	UML and C++ A practical approach to OO Development, 1997

Detailed Syllabus
Lecture-wise Breakup

Course Code	20B12CS331	Semester : Odd	Semester 5th Session 2023-2024
			Month: July 2023 to Dec 2023

Course Name	Fundamentals of Machine Learning

Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dharamveer Rajpoot (62), Hmani Bansal (128)
	Teacher(s) (Alphabetically)	Anil Kumar Mehto, Dharamveer Rajpoot, Hmani Bansal

COURSE OUTCOMES		COGNITIVE LEVELS
C330-1.1	Understand the mathematical concepts of machine learning approaches.	Understand (Level 2)
C330-1.2	Apply the fundamentals of linear algebra and probability theory to the machine learning problems.	Apply (Level 3)
C330-1.3	Apply the concepts of regression analysis and vector calculus to the machine learning models.	Apply (Level 3)
C330-1.4	Analyze the role of dimensionality reduction and density estimation for machine learning problems	Analyze (Level 4)
C330-1.5	Evaluate and test the significance of machine learning results statistically.	Evaluate (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Machine learning	Why machine learning, learning problems, types of learning: supervised, unsupervised, semi-supervised learning, fundamentals of machine learning	02
2.	Linear Algebra	Linear equations, solving linear equations, matrices, Cholesky Decomposition, singular value decomposition, matrix approximation, vector space, Norms, inner product, length and distances, angles and orthogonality, orthogonal complement, inner product, orthogonal projections and rotations, linear independence, linear mapping, Affine spaces	09
3.	Probability Theory	Discrete and continuous probability, sum rule, product rule, Baye's Theorem, Gaussian Estimation, conjugacy and exponential family, inverse transform, Hidden Markov model	05
4.	Regression Analysis	Problem formulation, parameter estimation, linear regression vs non-linear regression models, univariate vs multivariate regression, regression using least squares, logistic regression in machine learning	05

		Amendments to the constitution	
2.	Organs of the Government	The Executive: President, Prime Minister and Governor- appointment, powers and functions The Legislature: Parliament and its components- Lok Sabha and Rajya Sabha (composition and functions) The Judiciary: Supreme Court-composition, functions, appointment and jurisdiction	8
3.	Nature of Federalism in India	Centre-State Legislative Relations Centre-State Administrative Relations Centre-State Financial Relations Special Provisions of some state and the 5th and 6th schedule Emergency provision	8
4.	Local Governance in India	Urban local governance: Municipality-Structure & Functions Rural Local governance: Panchayat-Organization and Powers Civil Society: the participation of the people in local governance	8
5.	Traditional knowledge	Kautilya- Theory of state Mandala theory Saptanga theory	6
6.	Challenges to Indian Democracy	Caste as a critical factor in the Indian Constitution Gender as critical to the process of Constutionalization	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance, Quiz, Project)
Total	**100**

Project: Projects based on important Supreme Court judgments have to be submitted by the students as a part of the project-based learning method. This would help the students to know about the interpretation of

the various rights done by Supreme Court which would help them in their workplace as well as in general life.

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	A.A. George, *Important Judgements that transformed India*, New Delhi: McGraw Hill, 2020
2.	B. Chakraborty, *Indian Constitution: Text, Context and Interpretation,* New Delhi: Sage Publications, 2017
3.	B.K.Sharma, *Introduction to the Constitution of India*, New Delhi: Prentice Hall of India, 2002
4.	M.Laxmikanth, *Indian Polity*, 6th edition, Noida: McGraw Hill, 2019
5.	M.P.Singh and R. Saxena, R, *Indian Politics: Contemporary Issues and Concerns*, New Delhi: PHI Learning, 2008
6.	R. Kangle, *Arthashashtra of Kautilya*, New Delhi: Motilal Publishers, 1997
7.	Videos- Samvidhan series produced by Rajya Sabha Television .https://www.youtube.com/watchᵥ0U9KDQnIsNk

Course Code	21B12HS312	Semester: Odd (specify Odd/Even)	Semester: 5ᵗʰ Session: 2023 -2024 Month from: July-December
Course Name	**Management Accounting**		
Credits	03	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Purwa Srivastava
	Teacher(s) (Alphabetically)	Dr Purwa Srivastava

COURSE OUTCOMES		COGNITIVE LEVELS
C303-10.1	Understand various aspects of the management accounting system including ethical conduct for accountants	Understand (C2)
C303-10.2	Understand cost behaviour and apply cost-volume-profit analysis in decision making	Apply (C3)
C303-10.3	Understand basic accounting concepts and analyze financial statements of a business organization	Analyze (C4)
C303-10.4	Analyze various costing systems for cost allocation and pricing decisions	Analyze (C4)
C303-10.5	Evaluate the master budget and carry out variance analysis for planning and management control decisions	Evaluate (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Accounting concepts and financial statements	Accounting Concepts, principles, accounting equation, analysis of Balance sheet, Income statement, statement of changes in stockholders' equity, statement of cash flows. Common size statement, trend analysis and ratio analysis	7
2.	Management	Meaning of Management Accounting, Influences on	7

		accounting system	accounting systems, Ethical conduct for accountants	
3.	Cost Concepts and cost behaviour	Identifying resources, Activities, Costs and Cost drivers; Variable and Fixed cost behaviour; Cost-Volume-Profit Analysis	7
4.	Cost Management Systems	Direct, Indirect cost; Cost allocation; Traditional and Activity Based costing systems, special orders, pricing decision, cost-plus pricing, target costing, make or buy decision	7
5.	Budgetary Control	Introduction to budgets; Functional budgets, Master budgets, Fixed and flexible budgets, Budgets as financial planning models, Variance analysis	8
6.	Management control system	Organizational goal and performance measures, designing a management control system	6

Total number of Lectures	**42**

Evaluation Criteria
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (assignments, class test, project)
Total	**100**

Project-based learning- The students will be given a group project to identify a simple business, one with at least two products, two services or one product & one service. They will estimate the fixed and variable costs related to the business and carry outa Cost-Volume-Profit analysis to determine the Break-even sales of the business. Also, they will determine the cost of products/services using Activity-based Costing. Lastly, the students will prepare a projected master budget for the next three years which includes the sales budget, operating expenses budget, cash budget, purchase budget, projected balance sheet, profit and loss account and so on.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Charles T. Horngren, Gary L. Sundem, Jeff O. Schatzberg, Dave Burgstahler, Introduction to Management Accounting, 16th Edition, Pearson Publication, 2014.
2.	Anthony A. Atkinson, Robert S. Kaplan, Ella Mae Matsumura, S. Mark Young, G. Arun Kumar, Management Accounting, 5th Edition, Pearson Publication, 2009.
3.	Arora, M.N. Cost and Management Accounting, Himalaya Publishing, 4th Edition, 2018.

4.	Hingorani, Ramanathan and Grewal, Management Accounting, S. Chand Publications, 2003.
5.	Ghosh, T. P., Financial Accounting for Managers, 4th Edition, Taxmann Publications, 2009.
6.	Maheshwari, S.N., Maheshwari, S.K., Financial Accounting, 10th ed, Vikas Publishing House.
7.	Pandey, I.M., Financial management, 11th ed, Vikas Publishing House Pvt Ltd, 2015
8.	Chandra, P., Financial Management Theory and Practice, 7th ed., Tata McGraw Hill, 2007.
9.	Chawla, M, Chawla, C and Gupta, A. "India: Anti-corruption Compliance in India" Mondaq, January, 2021. Accessed on: 30th October 2021. Link: https://www.mondaq.com/india/white-collar-crime-anti-corruption-fraud/1022326/anti-corruption-compliance-in-india
10.	Tangdall, S. "The CEO of Starbucks and the Practice of Ethical Leadership", Santa Clara University, 29th August 2018. Accessed on: 30th October 2021. Link: https://www.scu.edu/leadership-ethics/resources/the-ceo-of-starbucks-and-the-practice-of-ethical-leadership/

Detailed Syllabus

Course Code	22B12PH311	Semester: Odd	Semester: 5th Session: 2023-2024 From: July to December
Course Name	Engineering Materials and Technology		
Credits	3	**Contact Hours**	3

Faculty (Names)	Coordinator(s)	Dr. Alok P. S. Chauhan
	Teacher(s) (Alphabetically)	Dr. Alok Pratap Singh Chauhan

COURSE OUTCOMES After completion of the course, students will be able to:		COGNITIVE LEVELS
C3O1-2.1	Recall the importance of engineering materials existing in the environment around us.	Remembering (C1)
C3O2-2.2	Explain and compare the different properties of the materials along with their broad classifications.	Understanding (C2)
C3O3-2.3	Apply the knowledge to analyze and use the different processes of the materials manufacturing.	Applying (C3)
C3O4-2.4	Apply the knowledge to develop/ choose materials for advanced engineering applications including robotic, drone and aerospace.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Materials	Broad categorization of materials, Structure, property and performance relationship in materials. Engineering Materials Development in India.	4
2.	Material Properties	Review of material properties. Fracture, fatigue, diffusion and creep. Failure of materials. Material Deformations. Durability, oxidation, corrosion and degradation. Basics of Phase Diagrams and Diffusion.	8
3.	Ceramics and Metals	Metals and Alloys. Strengthening and degradation, corrosion prevention. Material Strengthening. Sub-classification, processing and properties of traditional and advanced ceramics. Phase diagrams using CALPHAD approach for ceramics and metals.	8
4.	Polymers and Wood	Introduction and classification, polymeric structure, effects of glass transition temperature, polymer mechanical properties. Classification and facets of wood.	3
5	Material Composites	Composites: polymer matrix, metal matrix, ceramic matrix, carbon-carbon. Longitudinal and transverse modulus. Composite making methods.	6
6.	Processing and Selection of Material	Manufacturing Processes and Design, Instruments and Furnaces. Materials, Environment and Sustainability. Automation in Materials Processing, Laser ablation of materials in additive manufacturing.	7
7	Development	Exploring materials development using computer software tools. Python packages and machine learning algorithm. Material Analysis using PyMKS	4
		Total number of Lectures	**40**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material:	
1.	Callister, W. D., Material Science and Engineering: An Introduction, Wiley publication, 2014
2.	Ashby, Michael F. & Jones, David, Engineering materials, Elsevier publication, 2018
3.	Ashby, Michael F., Materials selection in mechanical design, Elsevier publication, 2019
4.	Jones, Robert M., Mechanics of composite materials, Taylor & Francis publication, 2015
5.	Chopra, Inderjit & Sirohi, Jayant, Smart structures theory, Cambridge press, 2013
6.	Raghavan, V., Materials Science and Engineering, Prentice Hall of India, 2004
7.	Bolton, W., Engineering Materials Technology, Elsevier, 2013, 1993

Project Based learning: Different groups of students with 3-4 students in each group may be formed and these groups may be given to complete a task like collecting and classifying the materials for different applications. Students may be given a task of preparing data on current and futuristic materials and processes. Students can explore and interact with different industry and come out with their understanding and interpretation. They can use different commercially available software tools to do designing and prediction. Within each of these problem domains, the students will learn to work in a team. It will improve their analytical skills and the students will learn to achieve their common goal through mutual discussion and sharing of knowledge, information & understanding.

Economics of Agriculture: Issues & Development

Course Code	23B12HS312	Semester: ODD	Semester V Session 2023 -2024
			Month from: July 2023-Dec2023
Course Name	Economics of Agriculture: Issues & Development		
Credits	03	Contact Hours	2-1-0

Faculty (Names)	Coordinator(s)	Dr. Vandana Sehgal
	Teacher(s) (Alphabetically)	Dr. Vandana Sehgal

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
CO1	Understand the significance of agricultural sector in economic development **Skill Development**	Understanding Level (C2)
CO2	Examine the working of marketing institutions and the players in marketing of agricultural commodities and the major sources of agricultural finance **Skill Development**	Applying Level (C3)
CO3	Link the agricultural policies and its effect on sustainable agricultural development **Skill Development**	Analyzing Level (C4)
CO4	Assess the impact of globalization on agricultural development. **Skill Development**	Evaluating Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
Module-I	ROLE OF AGRICULTURE IN ECONOMIC DEVELOPMENT	Nature and scope of Agricultural Economics; Role of agriculture in economic/rural development - Inter-sector Linkages of Agriculture- Barriers to Agricultural Growth-Schultz Theory of Transformation of Traditional Agriculture; Mellor's theory of Agricultural development - Boserup's Theory of Agricultural Development - The Chayanov Farm Household model - Barnum–Squire Farm Household Model - Hayami-Ruttan Induced Innovation Hypothesis **Skill Development**	8
Module-II	AGRICULTURAL	Market intermediaries and their role-Problems in	8

	MARKETING AND PRICE ANALYSIS	Agricultural Marketing from Demand and Supply and Institutions sides - Need for regulation in the present context, Role of Information Technology and telecommunication in marketing of agricultural commodities - Market research-Market information service - electronic auctions (e-bay), e-Chaupals Skill Development	
Module-III	**AGRICULTURAL PRODUCTION ECONOMICS**	Various Types of Factor-Product, Factor-Factor, and Product Product Relations; Role of Farm Size and Structure in Equilibrium, Determination of optimal levels of production and factor application - Optimal factor combination and least cost combination of production - Theory of product choice; selection of optimal product combination. Skill Development	9
Module-IV	**AGRICULTURAL FINANCE**	Agricultural lending – Direct and Indirect Financing - Financing through Co-operatives, NABARD and Commercial Banks and RRBs. Role and Importance of Agricultural Finance. Financial Institutions and credit flow to rural/priority sector Skill Development	8
Module-V	**AGRICULTURAL DEVELOPMENT AND POLICIES**	Development issues, poverty, inequality, unemployment and environmental degradation – Models of Agricultural Development - policy options for sustainable agricultural development, Globalization and the relevance of development policy analysis Skill Development	9
		Total number of Lectures -42	

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Assignment & Quiz)
Total	**100**

Project-based Learning: Each student in a group of 4-5 will choose a topic and submit a report focused on India's Agricultural Issues and Development, based on the following parameters: Agricultural Productivity, Crop Diversification, Technology Adoption, Agricultural Finance, Agricultural Marketing and Supply Chains, Government Policies and Initiatives, Rural-Urban Linkages, and Sustainable Agriculture. Exploring these fundamental agricultural indicators will enhance students' understanding of the diverse challenges and opportunities in the agricultural sector, equipping them with knowledge to contribute effectively to public and private decision-making bodies in the pursuit of agricultural development and sustainability.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Agricultural Economics: Principles and Policy" by David L. Debertin,2012
2.	Principles of agricultural economics markets and prices in less developed countriesby David Colman And Trevor Young, Cambridge University Press
3.	Agricultural Development: An International Perspective" by Alain de Janvry and Elisabeth Sadoulet
4.	Agricultural Economics" by H. Evan Drummond and John W. Goodwin,2013
5.	Lekhi R.K. & Singh Joginder, Agricultural Economics, Kalyani Publishers, New Delhi.
6.	Priniples of Agricultural Economics by Andrew Barkley and Paul W. Barkley, Routledge Taylor and Francis Publications, 2013

| CO Code | Program Objectives | | | | | | | | | | | | | |
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
C303-11.1						1	2					3		
C303-11.2						2					2	3		
C303-11.3						2	1				1	3		
C303-11.4						3	3				2	3		
Average						2	2				2	3		

Matrix Computations (16B1NMA533)

Detailed Syllabus

Course Code	16B1NMA533	Semester - Odd (specify Odd/Even)	Semester 5th Session 2023 -2024 Month from July 2023 - Dec 2023
Course Name	Matrix Computations		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Amita Bhagat and Dr. Neha Singhal
	Teacher (s) (Alphabetically)	Dr. Amita Bhagat, Dr. Neha Singhal, Dr. Pato Kumari

COURSE OUTCOMES		COGNITIVE LEVELS
C301-3.1	recall the basics of matrix theory and system of linear equations.	Remembering Level(C1)
C301-3.2	explain matrix inversion by partitioning/elementary matrices, vector spaces, inner product spaces and matrix norms.	Understanding Level (C2)
C301-3.3	solve the system of linear equations and eigen value problems using direct and iterative methods.	Applying Level (C3)
C301-3.4	analyze systems of differential and difference equations arising in dynamical systems using matrix calculus	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Matrix Algebra	Review of matrices, partitioning, block diagonal matrix, elementary matrices, Inverse of a matrix by partitioning.	6
2.	Linear System of equations	Existence and uniqueness of solution for system of linear equations. LU decomposition, Crout's and Doolittle's method, Cholesky factorization. Gauss Siedel, Gauss Jacobi and partial pivoting.	6
3.	Vector and Inner Product Spaces	Vector spaces, Subspaces, dimension and basis, p-norms of vector, Inner product, Norm using inner product and norms of a matrix.	6
5.	Orthogonality	Orthogonal and orthonormal sets, Gram-Schmidt process, QR factorization.	4
4.	Eigen value Problems	Eigen values and Eigenvectors, spectral radius, Greshgorin's theorem, Jacobi method, Givens rotations method and Householder's method, Power and Inverse power methods, Q-R algorithm.	12
6.	Matrix Calculus	Powers and functions of matrices, application to solve discrete dynamical systems $x(t+1) = Ax(t)$, $x(0) = \alpha$ and a system of differential equations of the form $dx/dt = Ax$, $x(0) = \alpha$.	8
		Total number of Lectures	42

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Quizzes and Tutorial)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Bronson, R**., Matrix Methods an Introduction, Academic Press, 1991.
2.	**Golub, G. H., Loan, C. F. V.,** Matrix Computations, 4th Edition, Johns Hopkins University Press, 2013.
3.	**Datta, K. B.**, Matrix and Linear Algebra, 3rdEdition, Prentice Hall of India, 2016.
4.	**David, W. Lewis**., Matrix Theory, World Scientific, 1991.

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C301-3.1	2	2	1									2		
C301-3.2	3	2	2	2								2		
C301-3.3	3	3	3	2								2		
C301-3.4	3	3	3	2					1			2		
Avg	2.8	2.5	2.3	2					1			2		

Basic Numerical Methods (17B1NMA531)

Approximation and errors in computation, Bisection Method, Regula- Falsi Method, Secant Method, Iterative method, Newton-Raphson Method, finite differences, Newton's Forward and Backward interpolation, Bessel's and Sterling's central difference operators, Laplace-Everett's formula, Newton's divided difference formula, Lagrange's interpolation formula, derivatives using difference operators, Numerical integration formulas, Gauss elimination method, LU decomposition method, , Gauss-Seidel method, Picard's method, Euler's methods, Runge-Kutta method, Milne's method, Finite-Difference method.

Course Description

Course Code	17B1NMA531	**Semester** - Odd	**Semester** V **Session** 2022-23 **Month from** Jul 2023- Dec 2023		
Course Name	Basic Numerical Methods				
Credits	3		**Contact Hours**	3-0-0	
Faculty (Names)	**Coordinator(s)**	Dr. Dinesh C. S. Bisht			
	Teacher(s) (Alphabetically)	Dr. Dinesh C. S. Bisht			

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above-mentioned course, the students will be able to:		
C301-5.1	relate the concepts of approximation, numerical solution, and errors in computation.	Remembering (C1)
C301-5.2	demonstrate the understanding of approximation and basic numerical methods	Understanding (C2)
C301-5.3	apply numerical methods for interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations	Applying (C3)
C301-5.4	analyse the physical problem to establish mathematical model and use appropriate method to solve	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Approximation and Errors in Computation	Errors, relative error, absolute error, error in series approximation.	02
2.	Algebraic and Transcendental Equations	Bisection Method, Regula- Falsi Method, Secant Method, Iterative method, Newton-Raphson Method, convergence.	07
3.	Interpolation	Finite Differences, Relation between difference operators, Newton's Forward and Backward Interpolation, Gauss Backward Interpolation,	08

		Bessel's and Sterling's central difference operators, Laplace-Everett's formula, Newton's divided difference formula, Lagrange's interpolation formula.	
4.	Numerical Differentiation and Integration	Derivatives using Newton's Forward and Backward Interpolation, Bessel's and Sterling's central difference operators, Maxima and minima of a tabulated function. Trapezoidal, Simpson's, Boole's and Weddle's rules, Euler-Maclaurin formula.	11
5.	System of Linear Equations	Gauss Elimination method, LU decomposition method, Gauss-Seidel Method.	05
6.	Numerical Solution of Ordinary Differential Equations	Picard's method, Euler's method, Modified Euler's method, Fourth order Runge-Kutta method, Milne's method for first order, second order and simultaneous differential equations, Finite-Difference Method	09
Total number of Lectures			**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials, PBL)
Total	**100**

Project Based Learning: Students will be divided in a group of 4-5 to collect literature and submit a report on application of different numerical methods to solve practical problems based on systems of linear equations and ordinary differential equations.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**C. F. Gerald and P.O. Wheatley,** Applied Numerical Analysis, 7th Ed., Pearson Education, 2004.
2.	**M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age International, New Delhi, 2014.
3.	**R. S. Gupta,** Elements of Numerical Analysis, 2nd Ed., Cambridge University Press, 2015.
4.	**S.D. Conte and C. deBoor,** Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., McGraw-Hill, New York, 1980.

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301-5.1	3	2	1	1								2			
C301-5.2	3	2	2	1								2			
C301-5.3	3	2	2	1								2			

C301-5.4	3	2	1	1							2			
C301-5.5	3	2	2	1							2			
C301-5.6	3	3	2	1							2			
Avg	3	2	2	1							2			