Detailed Syllabus
Lecture-wise Breakup

Subject Code	15B11EC611	Even-Semester	Semester: 6th Session: 2021 -2022
			Month: February – June
Subject Name	Telecommunication Networks		
Credits	3	Contact Hours	40

Faculty (Names)	Teacher(s) (Alphabetically)	1. Dr. Alok Joshi 2. Dr. Ankur Bhardwaj 3. Dr. Pankaj Kr. Yadav 4. Dr. Bhagirath Sahu

COURSE OUTCOMES		COGNITIVE LEVELS
C315.1	Understand the basic concepts of Telecommunication network model, Traffic Engineering and Switching technologies.	Understanding Level (C2)
C315.2	Understand the concepts of OSI model and analyze the various error and flow control mechanisms introduced by data link layer.	Analyzing Level (C4)
C315.3	Understand the TCP/IP protocol, routing algorithm and apply the concept of subnetting to allocate and distribute the logical addresses in a network.	Applying level (C3)
C315.4	Understand concept of LAN access protocols, ISDN, B-ISDN and ATM, their implementation and performance issues.	Understanding Level (C2)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Telecommunication network model	Telecommunication network model, Different networks types	2
2.	Switching technologies	Switched Communication Networks, Circuit Switching networks, Time Division Switching-Time Division Space Switching, Time Division Time Switching, Time Multiplexed Time Switching and TSI, Packet Switching Principles-Datagram and Virtual Circuit Approach, Message switching. Traffic engineering.	12
3	Computer Networks	Seven layered OSI model, Functions of different layers, primitives and services.	2

		Physical layers.	
4	Detailed working of data link	Data link Control, Flow Control, Stop and Wait flow Control, Sliding Window Flow Control, Error Control, Go-Back-N ARQ, Selective-Reject ARQ, Performance Analysis, HDLC.	6
5.	Network Layer and Internet Protocol (IP)	Basic Principles of Network layer, IPv4, IPv6, IP Addressing, Subnetting, Supernetting, Routing Schemes-Distance Vector routing, Link-State routing, Hierarchical routing.	6
6	Transport and TCP/UDP description	Basic Principles of Transport Layer and TCP/UDP description. Congestion control and Quality of Service (QoS)	6
7	Local area networks	LAN Protocols-ALOHA, CSMA, CSMA-CD, Implementation and performance issues.	4
8	ISDN, B-ISDN, ATM.	Introduction to ISDN, B-ISDN and ATM.	2
		Total number of Lectures	**40**

Project based learning: Here, students will learn the basic concepts of circuit switched Telephony and packet switched data networks (TCP/IP). These concepts are utmost importance for designing, implementing and testing of telecommunication networks.Students will be will doing assignments on different topics of switching systems and different TCP/IP layers.

Evaluation Criteria

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

      a) Attendance and Performance = 10
      b) Class Test/Quiz = 10
      c) Assignment   = 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.	W. Stallings, Data & Computer Communication, PHI
2.	B. A Forouzan, DATA COMMUNICATIONS AND NETWORKING, 4th Edition TMH
3.	A.S. Tanenbaum, Computer Networks, PHI
4.	John C. Bellamy, Digital Telephony, 3rd Edition, Wiley.

5.	Thiagarajan Viswanathan, Telecommunication Switching Systems and Networks, PHI

Course Code	15B11EC613	Semester: Even	Semester: 6th Session: 2021 -2022
			Month: February – June

Course Name	Control Systems		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Megha Agarwal, Dr. Shamim Akhter
	Teacher(s) (Alphabetically)	Dr. Megha Agarwal, Dr. Shamim Akhter

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Classify the open loop and closed loop control systems and construct mathematical model for physical systems.	Applying Level (C3)
CO2	Solve complex systems through block diagram reduction method and signal flow graph technique.	Applying Level (C3)
CO3	Determine transient response and steady state response of the systems using standard test signals.	Evaluating Level (C5)
CO4	Analyze the stability of the system and select suitable controllers and compensators for linear time invariant system.	Analyzing Level (C4)
CO5	Apply time domain and frequency domain techniques to identify the stability of control systems.	Applying Level (C3)
CO6	Solve continuous time and discrete time systems using state variable approach.	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Control System	Development of control systems, non feedback and feedback systems, negative feedback a means of automatic regulation, basic classification of control systems	3
2.	Modeling and Mathematical Representation of Systems	Block diagram simplification of continuous-time systems, Classification of system models, input – output description of systems, signal flow graph representation	8
3.	Time Domain Analysis and Design	Time domain response, steady state error and error coefficients, design considerations for second order systems, time domain response considerations for higher order systems. PID Controller	7
4.	Stability Analysis for continuous-time systems	Basic stability concept of linear systems, absolute stability criteria for continuous-time systems, relative stability Concepts	5
5.	Root Locus Method and Design in Time Domain	Fundamentals of Root Locus, construction of root loci, root contour diagram	6
6.	Frequency Response Analysis	Bodes plot and Nyquist plot , Gain Margin & Phase Margin, stability analysis	7

	and Design		
7.	State Variable Approach to Time Domain Analysis	State variable representation of continuous-time systems; System Response and State Transition Matrix (STM); Applications of STM.	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance : 10 Marks, Quiz:15 Marks)
Total	**100**

Project Based Learning: Simulate time response of continuous time systems, pole-zero plot based stability analysis and root locus analysis using Matlab.

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.	I. J Nagrath and M. Gopal, Control Systems Engineering, Fifth edition, New age International, 5th Edition, 2009.
2.	Normal S. Nise,, Control Systems Engineering, 7th Edition, John Wiley,2014
3.	K.Ogata, Modern Control Engineering, 5th Edition, Prentice Hall, 2010

Detailed Syllabus
Lab-wise Breakup

Course Code	15B17EC671	Semester VI (Even) (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June	
Course Name	TELECOMMUNICATION NETWORKS LAB			
Credits	1		Contact Hours	2

Faculty (Names)	Coordinator(s)	Bhagirath Sahu, Pankaj Kumar Yadav
	Teacher(s) (Alphabetically)	Alok Joshi, Bhagirath Sahu, Pankaj K. Yadav

COURSE OUTCOMES		COGNITIVE LEVELS
CO375.1	Learn about network simulator, and building/installing NS2 for conducting network simulation and summarizing OSI, TCP & UDP	Understanding Level (C2)
CO375.2	Set up and anlaysis of the wired and LAN networks and understanding UDP/TCP agents with CBR/FTP traffic source respectively	Analyzing Level (C4)
CO375.3	To create and analyze the mobile ad-hoc network and heterogenous networks and routing algorithm.	Analyzing Level (C4)
CO375.4	To label and explain data trace file (.tr) of Wired, Wireless and LAN Networks and evaluating throughput in Wired networks (with and without errors).	Evaluating Level (C5)

Module No.	Title of the Module	List of Experiments	CO
1.	Introduction to NS2 and Linux	1. (a) To learn about network simulator, and use NS2 for conducting network simulation including LINUX commands. (b) To learn installing NS2 in Fedora.	CO1
2.	OSI Model	2. (a) Introduction to OSI, TCP & UDP. (b) To set up a network with two nodes; link them with duplex link, 10ms propagation delay, 1Mbps rate and DropTail procedure. Use Agent UDP with CBR traffic source. 3. To set up a network with two nodes; link them with duplex link, 10ms propagation delay, 1Mbps rate and DropTail procedure. Use FTP over Agent TCP.	CO2
3.	Ethernet	4. To implement wired LAN connection in NS2	CO2
4.	Mobile Networks	5. To create a mobile ad-hoc network with 3 nodes in 500*400 topography with following initial positions and movements: Node 0 (5, 5) Node 1 (490,285) Node 2 (150,240) At t = 10, 0 moves towards (250,250) at 3m/sec. At t =15, 10 moves towards (45,285) at 5m/sec. At t =110, 100 moves towards (480,300) at 5m/sec.	CO3
5.	Wired-cum-Wireless Networks	6. To create a Heterogeneous Network (wired cum wireless network).	CO3
6.	Interpretation of Trace Files	7. To interpret data trace file (.tr) of Wired, Wireless and LAN Networks.	CO4

| 7. | Throughput Calculation and Error Analysis | 8. Throughput calculation for TCP or UDP in Wired network.
9. To create a network with 4 nodes 0-2, 1-2, 2-3 with TCP from 0-3 and UDP from 1-3. Apply an error model on link 2-3 with error rate 0.2 and uniform distribution. Apply queue monitor on 2-3 link and interpret any five lines of qm.out file.
10. To create a network with 5 nodes, and apply uniform, exponential and constant error model with error rate 1% on 3 different links. | CO4 |

Project-Based Learning: NS2 provides an interactive and graphical platform for the simulation of wired-cum-wireless networks. The TCL programming to generate any telecommunication networks is taught to the students, allowing further to analyze the performance of the network in the presence and absence of any error due to the channel fading or interference.

Evaluation Criteria

Components	**Maximum Marks**
Mid-Sem Viva	20
Final Viva	20
Day-to-Day	60
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.	The ns Manual (formerly ns Notes and Documentation), http://www.isi.edu/nsnam/ns/ns-documentation.html
2.	W. Stallings, Data & Computer Communication, PHI
3.	B. A Forouzan, DATA COMMUNICATIONS AND NETWORKING, 4th Edition TMH
4.	A.S. Tanenbaum, Computer Networks, PHI

Course Code	17B1NEC734	Semester EVEN	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	RF and Microwave Engineering		
Credits	3	Contact Hours	3L

Faculty (Names)	Coordinator(s)	Prof. Shweta Srivastava
	Teacher(s) (Alphabetically)	Prof. Shweta Srivastava, Monika

COURSE OUTCOMES		COGNITIVE LEVELS
C332-3.1	Explain the concepts of microwave circuits and scattering parameters.	Understanding Level (C2)
C332-3.2	Evaluate the performance of several waveguide components and determine their responses and applications.	Evaluating Level (C5)
C332-3.3	Analyze the behaviour of microwave sources based on solid state devices and tubes at microwave frequencies.	Analyzing Level (C4)
C332-3.4	Determine mearurent parameters of microwave components and understand the ISM applications of Microwave Energy.	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to RF and Microwave Engineering	History of Microwaves, applications of Microwaves, Maxwell's Equations.	2
2.	Microwave Transmission Lines	Review of Transmission lines, Line Equations. Microwave Integrated Lines: Microstrip line, Strip line, CPW line.	3
3.	Impedance matching	$\lambda/4$ Transformer, Tapered Lines :Exponential	3
4.	Scattering Parameters	S-parameters: definition, properties, 2-port, 3-port and 4-port.	4
5.	Microwave Components	H-plane, E-plane and Magic Tee, Isolator, Circulator, Directional Coupler, Cavity Resonators, Q of Cavity Resonator, Rectangular waveguide cavities.	10
6.	Microwave Devices and Sources	Microwave semiconductor devices, Schottky diode, Gunn diode, Microwave Tubes.	7
7.	Microwave Measurements	Impedance and Power Measurement Vector Network Analyzer, Spectrum analyzer.	4
8.	RF Filters	Classification of filters, Filter Design by Insertion loss method	3

9.	Microwave Propagation and Applications	Industrial, Scientific and Medical applications of Microwave Energy, Biological effects of microwave energy.	4
		Total number of Lectures	40

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	20
PBL	05
Total	**100**

Project Based Learning:

Microwave Engineering is a fundamental course in Electronics and Communication Engineering. In this course, a brief introduction about basics of RF and Microwave Engineering is presented, which can be utilized to impart knowledge to design various microwave circuits at high frequencies. The project based exercises using RF basics can be used for filter designing.

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.	D.M. Pozar, Microwave Engineering (2nd Ed.), John Wiley, 1998.
2.	S.Y. Liao, Microwave Devices and Circuits (3rd Ed.), Pearson, 2003.
3.	Peter A. Rizzi, Microwave Engineering, Pearson, 1998.
4.	B. R. Vishvakarma , R. U. Khan and M.K. Meshram , Microwave Circuit Theory and Applications, Axioe Books, 2012.

Subject Code		Semester EVEN	Semester: 6th Session: 2021 -2022
	17B1NEC741		Month: February – June
Subject Name			
	Digital Hardware Design		
Credits	3	Contact Hours	3-1-0
Faculty (Names)	Coordinator(s)	Dr. Shruti Kalra	
	Teacher(s) (Alphabetically)	Ms. Priyanka Kwatra, Dr. Shruti Kalra	

Course Outcomes		Cognitive Levels
C332-1.1	Design synchronous circuits using Finite State Machine approach	Analyzing Level (C4)
C332-1.2	Design and analyze asynchronous circuits	Analyzing Level (C4)
C332-1.3	Understand the advanced adders and multiplier circuit	Understanding Level (C2)
C332-1.4	Apply the concept of different ways of pulse or pattern generation	Analyzing Level (C4)
C332-1.5	Design digital circuits using VHDL	Analyzing Level (C4)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Finite State Machine (FSM)	FSM Design methodology, State Reduction, State Assignment, Implementation, and State Diagram partitioning, Mealy to Moore Conversion and vice-versa.	9
2.	Pulse Generation Technique	Sequence generation using Direct and Indirect Approach, Shift Register Based Approach, Clock Dividers (Integer/Non-Integer)	5
3.	Advanced Topics in Digital Circuits	Different Types of Adders, Parallel Prefix Adders, Multipliers,	9
4.	VHDL based Digital Circuit Design	Importance of HDL, Basic Language elements, VHDL syntax, entities, and architectures, concurrent and sequential constructs, hierarchical design and test benches, FSM modeling and simulation	10

5.	Asynchronous Finite State Machines	Asynchronous Analysis, Design of Asynchronous Machines, Flow table realization, reduction, state assignments and design, Cycle and race analysis. Hazards, Essential Hazards, and its removal	9
		Total Number of Lectures	42

Evaluation Criteria

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

Project Based Learning: Student will design and synthesize combinational and sequential circuits using VHDL.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	William Fletcher: An Engineering approach to digital design, PHI, 2012
2.	Z.Kohavi: Switching and Finite Automata Theory, 2nd Edition, Tata Mc-Graw Hill, 2001
3.	A. Anand Kumar : Fundamental of Digital Circuits, PHI, 4th Edition 2016
4.	J. M. Rabaey, A. Chandrakasan, B. Nikolic: Digital Integrated Circuits: A Design Perspective, 2nd Edition, Pearson Education Inc., 2016.
5.	Volnei A. Pedroni: Circuit Design with VHDL, 2nd Edition, MIT Press 2020

Detailed Syllabus
Lecture-wise Breakup

Subject Code	17B11EC731		Semester: Even	Semester: 6th Session: 2021 -2022
				Month: February – June

Subject Name	Mobile Communication			
Credits	3		Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Alok Joshi, Kuldeep Baderia
	Teacher(s) (Alphabetically)	Alok Joshi, Kuldeep Baderia

COURSE OUTCOMES		COGNITIVE LEVELS
C331-2.1	Explain the evolution of mobile communication and basics of all the wireless standards currently being employed.	Understanding Level (C2)
C331-2.2	Perform mathematical analysis of cellular systems and cellular capacity improvement designs.	Analyzing Level (C4)
C331-2.3	Analyze large and small scale propagation models and their design both mathematically and conceptually. Analysis of various fading models.	Analyzing Level (C4)
C331-2.4	Analyze architecture of 2G, 3G and 4G systems and issues associated with them. Formulate research problems based on the issues associated with 4G systems.	Analyzing Level (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Mobile communication system evolution	Evolution of mobile communication systems. 2G, 3G, and 4G systems. Block diagram of mobile communication system. Problems of mobile communication: spectrum, propagation. Near far problem.	3
2.	The cellular Concept – System Design Fundamentals	Introduction, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage & capacity in cellular system	8
3.	Mobile Radio Propagation	Free Space Propagation Model, Ground Reflection Model, Small scale Propagation, Impulse Response model of a multipath channel, Parameters of mobile multipath channels, Types of small scale fading, Rayleigh and Ricean distributions, Level crossing rates and Average fade duration.	12
4.	Multiple Access Techniques	FDMA, TDMA, CDMA and OFDMA techniques and their performance. Number of channels.	5
5.	Mobile communication network architectures	GSM: GSM standards and architecture, GSM Radio aspects, typical call flow sequences in GSM, security aspects. GPRS, UMTS.	8
6	Introduction to 4G systems	Long Term Evolution (LTE) and Worldwide	4

		Interoperability for Microwave Access (WiMax).	
		Total number of Lectures	**40**

Evaluation Criteria

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

Project based Learning Component: Here, students will learn frequency planning in mobile communication and designing the network in such a way so as to maximize the system capacity. System capacity is used to characterize the total number of users that can be supported by the system. As an alternate to measurements, different propagation models will be analyzed. Using some simulation tool (like MATLAB) performance of different propagation models (like Okumura, Hata, SUI, etc.) will be analyzed to find the best suited model for a particular wireless generation. Further to characterize the fading scenarios in wireless communication, simulations will be performed for different fading distributions like Rayleigh or Ricean. Summarizing, students will learn the simulations required to analyze the different aspects of wireless communication like system capacity, signal strength, and fading.

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.	**T. S. Rappaport, Wireless Communications (principle and practice), PHI/Pearson, 2002.**
2.	William C.Y. Lee, Mobile Cellular Telecommunications- Analog & Digital Systems, Mc.Graw Hill, 1995
3.	Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
4.	V.K.Garg, Principles and Applications of GSM, Pearson Education, 1999
5.	V.K.Garg, IS-95 CDMA and CDMA 2000, Pearson Education, 2000

Subject Code	18B11EC315	Semester: Even	Semester: 6th Session: 2021 -2022 Month: February – June
Subject Name	VLSI Design		
Credits	4	**Contact Hours**	4
Faculty (Names)	**Coordinator(s)**	Dr. Garima Kapur	
	Teacher(s) (Alphabetically)	Dr. Akanksha Bansal, Mr. Vinay A. Tikkiwal	

Course Objectives: This course aims to convey knowledge of basic concepts of circuit design using CMOS with emphasis on the design, optimization and layout. Special attention will be devoted to the most important challenges facing digital circuit designers today and in the coming decade, being the impact of scaling, deep submicron effects and timing.

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
CO1	Understand VLSI design flow, VLSI design styles, digital systems modeling using Verilog-HDL	Understanding Level (C2)
CO2	Demonstrate the operation of MOSFET, understanding technology scaling and its effects	Analyzing Level (C4)
CO3	Develop the concepts of static and dynamic characteristic of MOS inverters, combinational and sequential circuits	Analyzing Level (C4)
CO4	Understand the dynamic logic circuits, stick diagram, layout and working principle of different types of semiconductor memories	Analyzing Level (C4)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Introduction to VLSI	Overview of VLSI design methodologies, VLSI design flow, Design hierarchy, VLSI design styles.	3
2.	MOS Transistor Theory	MOS structure and operation, MOSFET I-V characteristics, Scaling and small-geometry effects, MOSFET capacitances, MOSFET models for circuit simulation	9
3.	MOS Inverters	Static and switching characteristics,	9

		Delay-time definitions, calculation of delay times, Inverter design with delay constraints, Static and switching power dissipation of CMOS inverter	
4.	MOS Logic Circuits	CMOS logic circuits, Complex logic circuits, Pass transistor logic, CMOS transmission gates, Sequential logic circuits, Dynamic logic circuits, Stick diagram, Layout, Layout design rules	13
5.	Semiconductor Memories	Working of Dynamic and Static Random Access Memory (DRAM, SRAM)	4
6.	System Design using HDL	Language fundamentals, Different modeling techniques using Verilog-HDL	4
		Total number of Lectures	42

Evaluation Criteria

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

PBL Component: Knowledge of VLSI Design industry, Basic of CMOS technology, CMOS circuits, power and delay calculations, CMOS technology layout and design rules, designs of memory and HDL language, all these topics develop designing and analysis ability in students.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	Sung-Mo Kang, ; Yusuf Leblebici ; Chulwoo Kim, "CMOS Digital Integrated Circuits: Analysis and Design", 4th Edition, McGraw-Hill Higher Education, Indian Edition,2019.
2.	J. M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson Education Inc., 2016.
3.	Neil Weste and David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson Education India, 2015.
4.	M.Morris Mano, Michael D.Ciletti, "Digital Design: With an Introduction to the Verilog HDL,VHDL, and System Verilog", 6th Edition, Pearson , 2018.

Course Code	18B15EC315	Semester Even	Semester: 6th Session: 2021 -2022
			Month: February – June

Course Name	VLSI Design Lab II		
Credits	1	Contact Hours	2

Faculty (Names)	Coordinator(s)	Satyendra Kumar, Saurabh Chaturvedi
	Teacher(s) (Alphabetically)	Archana Pandey, Kaushal Nigam, Priyanka Kwatra, Satyendra Kumar, Saurabh Chaturvedi, Shruti Kalra

COURSE OUTCOMES - At the end of the course, students will be able to		COGNITIVE LEVELS
C374.1	Relate the concepts of basic electronics circuits and recall the use/working of circuit simulation tools.	Remembering Level(C1)
C374.2	Understand and explain the current-voltage characteristics of NMOS and PMOS transistors and extraction of MOSFET parameters.	Understanding Level(C2)
C374.3	Apply the MOSFET theory in MOS-based circuits, e.g. MOS inverters, combinational and sequential MOS logic circuits.	Applying Level(C3)
C374.4	Analyze the static and switching characteristics of MOS inverters and examine the delay times. Analyze and simulate the schematic and layout of CMOS combinational and sequential logic circuits and examine their responses.	Analyzing Level(C4)

Module No.	Title of the Module	List of Experiments	CO
1.	Introduction to EDA tools (Cadence/Tanner)	Introduction to Cadence/Tanner tools: SPICE, Schematic Editor, Layout Editor. Transient analysis of RC circuit.	C374.1
2.	MOS transistors	To study the I-V characteristics of NMOS and PMOS transistors. To obtain theNMOS-FET parameters:k_n, v_{to}, v_t, γ and λ.	C374.2
3.	MOS inverters	To analyze the voltage transfer characteristics (VTC) of resistive-load NMOS inverter and calculate VOH, VOL, VIH, VIL and Vth. To analyze the voltage transfer characteristics (VTC) of CMOS inverter and calculate VOH, VOL, VIH, VIL and Vth.	C374.3
4.	MOS ombinational and sequential logic circuits	To analyze the transient response of CMOS inverter and calculate the propagation delay, rise time and fall time. To simulate the following logic gates and verify the truth tables: (a) Two-input NAND (b) Two-input NOR Layout design and simulation of NMOS and PMOS transistors. Layout design and simulation of CMOS inverter. Layout design and simulation of CMOS 2-input NAND gate. Simulation of a two-input XOR gate using CMOS transmission	C374.4

		gates. Simulation of a two-input multiplexer using CMOS transmission gates. Simulation of a CMOS D-latch.	

Evaluation Criteria

Components   **Maximum Marks**
Mid-semester viva20
End-semester viva20
Day-to-day performance60
(Lab record, experiment performance, discipline etc.)

Total   **100**

Project Based Learning: Students will learn EDA/CAD tools, MOS/CMOS logic layout design, which is the utmost requirement to design a VLSI chip. Therefore, students with the knowledge of CMOS combinational logics, can design and analyze VLSI system/sub-system based projects.

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.-M. Kang, Y. Leblebici, and C. Kim"CMOS Digital Integrated Circuits: Analysis and Design," 4th edition, McGraw-Hill Higher Education, Indian Edition,2019.
2.	J. M. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson Education Inc., 2016.
3.	N. H. E. Weste and D. M. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective," 4thEdition,Pearson Education India, 2015.

Course Code	18B12EC311	Semester:Even (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Advanced Radio Access Networks		
Credits	3	**Contact Hours**	3 (L)

Faculty (Names)	Coordinator(s)	Dr. Rahul Kaushik
	Teacher(s) (Alphabetically)	Dr. Rahul Kaushik

COURSE OUTCOMES		COGNITIVE LEVELS
C331-1.1	Recall the basic concepts of Digital Communication, Antenna and Wave Propagation, and Wireless Communication.	Remembering Level (C1)
C331-1.2	Identify the different components of wireless network based on the 3GPP reference network model.	ApplyingLevel (C3)
C331-1.3	Analyze the architecture and channel structure of LTE and also examine the LTE call flow.	AnalyzingLevel (C4)
C331-1.4	Explain the importance of Optimization and Pre-Launch Optimization in radio access network.	EvaluatingLevel (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Overview and evolution of Mobile Telephony, Telecom team structure, Generic network architecture, RAN network components, RAN life cycle.	6
2.	RF Basics	Concepts related to baseband signal processing, Microwave theory fundamentals, Concepts of radio propagation, Antenna Concepts, Fading in wireless communication.	6
3.	Radio Access Networks- Overview	Introduction to cellular concepts, Link adaptation, Power control, Generalized macro site overview, Generalized call flow, Introduction to KPI, Protocol layers, Standardization.	6
4.	Radio Access Network- LTE	Architecture of LTE, LTE Bearer, LTE QoS, LTE Radio Interface, Channel structure, Scheduling in LTE, Idle mode behavior, Power control in LTE, LTE mobility, LTE call flow.	18
5.	Radio Access Network Optimization	Optimization basics,RAN tuning and RAN optimization, Introduction to KPIs and Counters, Pre-launch optimization, Post-launch optimization.	6
		Total number of Lectures	**42**

Evaluation Criteria	
Components	**Maximum Marks**
T120	
T220	
End Semester Examination35	
TA	25 (Attendance, PBL/Assignment)
Total	**100**

Project based learning: Here, students will learn the process of radio network planning as it is of the utmost importance to plan the radio network as efficiently as possible. Radio network planning comprises of services relevant to network operators, regulatory organizations, and system suppliers, including: coverage analysis, frequency planning, network design, network implementation, network optimization in terms of coverage or capacity. By using propagation tools (like TEMS that is widely used by telecom operators) or some simulation tool like MATLAB, students will learn to measure, analyze, and optimize the mobile networks. In particular, they will learn the simulations for RF coverage predictions, field-strength measurements in wireless propagation.

	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.	Advanced Radio Access Network, Student Book, Ericsson AB 2018.
2.	T. S. Rappaport, Wireless Communications: Principles and Practice. Piscataway, NJ, USA: IEEE Press, 1996.
3.	TEMS Investigation, User Guide, ARAN Program-2018, Ericsson.
4.	Online resource material from NPTEL, Research Papers.

Course Code	18B13EC314	**Semester** Even	**Semester:** 6th **Session:** 2021 -2022 **Month:** February – June
Course Name	Machine Learning for Signal Processing		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	B Suresh	
	Teacher(s) (Alphabetically)	Dr. Vijay Khare, B Suresh	
COURSE OUTCOMES			**COGNITIVE LEVELS**
C331-3.1	Illustrate various machine learning approaches.		Understanding Level (C2)
C331-3.2	Experiment with the different techniques for feature extraction and feature selection.		Applying Level (C3)
C331-3.3	Apply and analyze various classifier models for typical machine learning applications.		Analyzing Level (C4)
C331-3.4	Make use of deep learning techniques in real life problems.		Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction and Basic Concepts	]: Linear algebra, Probability distributions, Representing signals, Machine Learning basics.	6
2.	Feature Selection	Introduction, Types of Feature Selection: Mutual Information (MI) for Feature Selection, Goodman– Kruskal Measure, Laplacian Score, SVD, Ranking for Feature Selection, Feature Selection for Time Series Data.	6
3.	Linear Models for Regression	Regression: Linear Basis Function Models, The Bias-Variance Decomposition	4
4.	Linear Models for Classification	Discriminant Functions,Probabilistic GenerativeModels, Probabilistic Discriminative Models,TheLaplaceApproximation	5
5.	Decision Tree Learning	Decision Tree Representation, Hypothesis space search, Inductive bias, Issues in decision tree learning	6

6.	Support Vector Machines	Linear maximum margin classifier for linearly separable data, Linear soft margin classifier, Kernel induced feature spaces, Nonlinear classifiers, Regression by SVM, SVM variants	6
7.	Introduction to Neural Networks and Deep Networks	Neural networks, Convolutional neural networks and applications.	7
		Total number of Lectures	40

Evaluation Criteria

Components	MaximumMarks
T1	20
T2	20
EndSemesterExamination	35
TA25 (Attendance, Performance, Assignments/Quiz, Project)	
Total	**100**

Project based learning: Students will apply machine learning frameworks for the classification problems with the help of programming assignments. Additionally, students in group sizes of two-three will prepare a review of the one CNN application using current research papers.

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.	Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2.	Deep Learning, I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
3.	The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. Friedman., 2nd Edition, 2008.
4.	Machine Learning, T. Mitchell, McGraw Hill, 1997.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	15B19EC691	Semester : Even	Semester: 6th Session: 2021 -2022
			Month: February – June
Subject Name	Minor Project - 2		
Credits	5	Contact Hours	NA

Faculty (Names)	Coordinator(s)	Mr. Ankur Bhardwaj, Mr. Raghvenda Kumar Singh
	Teacher(s) (Alphabetically)	NA

COURSE OUTCOMES		COGNITIVE LEVELS
C351.1	Identifying, planning and initiation of the individual projects in the domain selected by them, respectively.	Applying Level (C3)
C351.2	Analyze the potential research areas in the field of Embedded Systems, Signal Processing, VLSI, Communication, Artificial Intelligence and Machine Learning/Deep Learning etc.	Analyzing Level (C4)
C351.3	Survey the available literature and gain knowledge of the State-of-Art in the chosen field of study.	Analyzing Level (C4)
C351.4	Evaluate the existing algorithms of the domain selected and improvise the algorithm so that it yields better results than the existing metrics.	Evaluating Level (C5)
C351.5	Design and implement a working model, using various hardware components, which works as a prototype to showcase the idea selected for implementation.	Creating Level (C6)

Evaluation Criteria

Components	Maximum Marks
Mid SemesterEvaluation	40
Final Evaluation	40
Report	20
Total	**100**

Detailed
SyllabusLecture-
wiseBreakup

Course Code	16B1NHS634	Semester E even (specify Odd/Even)	Semester Session 2021-2022 Month from Jan to June	
CourseName	Theatre and performance(Value added)			
Credits	2		ContactHours	1-0-2

Faculty(Names)	Coordinator(s)	Dr Nilu Choudhary and Dr. Ankita Das
	Teacher(s) (Alphabetically)	Dr. Ankita Das and Dr. Nilu Choudhary

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C304-14.1	Demonstrate problem solving ability and effective life skills through theatre performances.	Understanding level(C2)
C304-14.2	Develop awareness of the role of these arts in human life	Understanding level(C2)
C304-14.3	Apply skills of listening, articulation, awareness and collaboration through the creation of performance.	Applying level(C3)
C304-14.4	Design and present an original performance alone or in collaboration with other artists.	Creating level(C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction of Theatre	History of theatre: role of theatre in human culture with special reference to India	2
2.	Characterization	Tips for developing character, thinking about thoughts, Flash –back, Performance	2
3.	Script Writing	Turning a story into a play ,How to write a one Act , setting the scene ,character , stage direction , Dialogues	3
4.	School of Drama	Natya-Shastra, Stanislavsky and Brecht	3
5.	Text and its interpretation	Mother Courage ,Galileo ,AadheAdhure (any one)	3
6.	Back-stage work	Management, planning, execution	1
		TotalnumberofLectures	**14**

Module No.	Titleofthe Module	ListofExperiments/Activities	CO
1.	Moving inSpace.	Students will be moving around the room, filling up the space, changing pace, changing direction, being aware of other people but not touching them. Find new ways of moving, with a different emphasis each time – smooth, jagged, slow, fast, heavy, light, high up, low down and so on. Every now and again Teacher will shout "Freeze! And Students need to freeze every muscle in your body. Absolutely NO LAUGH, LOOKING AROUND, OR MOVING. You will be out.	C304-14.1

		AbsolutelyNOLAUGH,LOOKINGAROUND,OR MOVING.Youwill beout.	
2.	Mirror Activity	A great way to get students aware of body movement and working together.	C304-14.1
3.	Characterization	Developing and analyzing characters to reveal the special qualities and personalities of the characters in a story, making character believable.	C304-14.2
4.	Script Writing	The more passionate you feel about your idea, the more attractive your play will be. Divide the idea into a beginning, middle and end.	C304-14.3
5.	Role Assignment	No acting or movement at this point – just sit together to speak and hear the script carefully. Discuss and clarify any confusing aspects of the script and any apparent challenges in bringing the script to the stage. Division of script into small "units" and rehearsed separately	C304-14.3
6.	Turning story into a play	Read thru each episode or unit separately "on its feet".Actors moving around the stage space. Set blocking for each episode. Use ideas generated from Mini-Episodes, and Staging with Images. Make sure the gestures, movements, and stage pictures tell the story clearly.	C304-14.3
7.	Stage blocking	Practice the blocking and the lines so that everyone knows what happens when and what their performance responsibilities are. Memorize lines. Work on making characters, relationships, and dialogue clear. This is a good place in which to use the Creating the Character lessons. Pay attention to vocal projection and articulation. Generate ideas about any technical elements you want to incorporate using the Transformation of Objects.	C304-14.3
8.	Script to performance	Finalize and run the entire play from beginning to end without stopping to check any additional rehearsal required to get everything running smoothly or not. Finally Perform!!	C304-14.4

Evaluation Criteria

Components	Maximum Marks
Mid Term	30
End Term	40
TA	30 (Script writing, End term stage performance)
Total	**100**

Project Based Learning: Students will be given a project in a group of 5-6 which would require them to use their imagination to form original stories with relatable characters and convert it into a script to be performed as a play. While putting together an entire performance would help them in learning organizational lessons such as team work, their efforts towards developing relatable characters would help them in analyzing the varied experiences and emotions of human life.

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc.(Textbooks, ReferenceBooks, Journals,Reports,Websitesetc.intheIEEEformat)
1.	Eric Bentley, ed., The Theory of the Modern Stage: An Introduction to Modern Theatre and Drama, Penguin Books, 1968
2.	Mark Fontier, Theory/ Theatre: An Introduction, New York: Routledge, 2002
3.	Michael Holt, Stage Design and Property, Oxford: Phaidon, 1986
4.	Michael Holt, Costume and Make-up, Oxford: Phaidon, 1988
5.	Natyashastra, tr. by AdyaRangacharya, New Delhi: Munshiram Manoharlal, 2006,
6.	G.J Watson, Drama: An Introduction. Macmillan International Higher Education, 2017.
7.	Micheal Mangan, The Drama, Theatre and Performance Companion. Basingstoke: Palgrave Macmillan, 2013.
8.	Kenneth Pickering Key Concepts in Drama and Performance. New York: Palgrave Macmillan, 2010.

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NPH632	Semester EVEN		Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	SOLID STATE ELECTRONIC DEVICES			
Credits	3		**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**		Dr. Dinesh Tripathi	
	Teacher(s) (Alphabetically)		NA	

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Define terminology and concepts of semiconductors with solid state electronic devices.	Remembering Level (C1)
CO2	Explain various electronic, optical and thermal properties of semiconductors; various techniques used in device fabrication.	UnderstandingLevel(C2)
CO3	Solve numerical problems based on solid state electronic devices.	ApplyingLevel(C3)
CO4	Examine the impact of various parameters on semiconductor devices and their performances.	AnalyzingLevel(C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Energy band and charges carriers in conductors	Bonding forces and energy bands in solids, charge carriers in semiconductors, carries concentrations, drift of carriers in electric and magnetic fields, Invariance of the Fermi level at equilibrium, optical absorption, Luminescence, Carrier lifetime and photoconductivity, diffusion of carriers	12
2.	Junctions	Fabrication of p-n junctions, equilibrium conditions, steady state conditions, reverse bias breakdown, recombination and generation in the transition region, metal semiconductor junctions, heterojunctions,	10
3.	Transistors	Field effect transistor (FET), Metal-insulator FET, Metal-insulator-semiconductor FET, MOS FET, Bipolar junction transistors	08
4.	Devices	Photodiodes, solar cell, light emitting diodes, semiconductor lasers, Negative conductance Microwave devices: Tunnel diode, IMPATT diode, Gunn diode	10
		Total number of Lectures	**40**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (5), Attend. (5), PBL (10) and Class performance (5)]
Total	**100**

Project based learning: To make a better understanding about the subject, groups of 4-5 students will be formed and a project on semiconductor devices viz. Gauss meter, Photodiode, Light Emitting Diode, Solar cell, Tunnel Diode, FET, MOSFET etc. will be allotted to each of the groups. The students will collect all the information's and understand about the basic principle, fabricationprocess and current research activities going on in the particular field. The students will also be encouraged to explore the field and create interactive simulations based on these devices.	

	Recommended Reading material:
1.	Donald A Neamen&Dhrubes Biswas, Semiconductor Physics and Devices, McGraw Hill Education
2.	S. M. Sze, Physics of Semiconductor devices, Wiley-Interscience
3.	Streetman and Banerjee, Solid State Electronic devices, PHI
4.	Umesh Mishra and Jasprit Singh, Semiconductor Device Physics and Design,

Course Code	16B19PH692	Semester Even	Semester: 6th Session: 2021 -2022
			Month: February – June
COURSE NAME	LIGHT EMITTING DIODES: BASICS AND APPLICATIONS		
Credits	2	Contact Hours	2-0-0

Faculty (Names)	Coordinator(s)	Dr. B.C. Joshi
	Teacher(s) (Alphabetically)	Dr. B.C. Joshi

COURSE OUTCOMES		COGNITIVE LEVELS
C305-6.1	Recall the basic concepts of semiconducting materials, working of p-n junction diode and light emitting diodes.	Remembering Level (C1)
C305-6.2	Explain the various physical parameters involved in designing and fabrication of LEDs.	Understanding Level (C2)
C305-6.3	Solve various problems related to efficiency, emission intensity and spectrum of LEDs.	Applying Level (C3)
C305-6.4	Analyze the problems in designing & fabricating blue, white and green high brightness LEDs.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	History of LEDs	History of SiC, GaAs, GaAsP, GaInP, GaN, and InGaN LEDs.	4
2.	Theory of Recombination's	Radiative and non-radiative recombination's, Low-level and high-level excitations, Bio-molecular rate equation for quantum well structure, Van Roosbroeck-Shockley Model, Einstein Model.	6
3.	LED Basics	Electrical properties: I-V characteristics, parasitic resistances, carrier distribution in homo and hetero junctions, carrier losses, carrier overflow in heterojunctions, Optical properties: Internal, external, extraction and power efficiencies, Emission spectra, escape cone and temperature dependency	6
4.	Growth & Fabrications	LED materials, Organic LEDs, Growth, Fabrication and Characterization Techniques	4
5.	Applications	Solid state lighting, White LEDs, HB LEDs, Color Mixing and Rendering, LED Drivers, Display Devices, AMOLED, Communication, High Voltage LEDs	10
		Total number of Lectures	30

Evaluation Criteria
Components   **Maximum Marks**
Mid Term Examination   30
End Semester Examination   40
TA   30 [Attendance + Class Tests, Quizzes, *etc* (09 M),Internal assessment and
          Assignments in PBL mode.

Total   **100**

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

1.	**Text 1:** Light-Emitting Diodes, Schubert E. Fred, Cambridge University Press, 3rd Edition 2018.
2.	**Reference:** Introduction to Light Emitting Diode Technology and Applications, Held Gilbert, Auerbach Publications, 2008.
3.	**Reference:** Light-Emitting Diodes; Materials, Processes, Devices and Applications, Editors: Jinmin Li, G. Q ZHANG, Springer, 2019

Project based learning: In a group of 3 to 5 a task will be assigned to the students, related to design and modelling of light emitting diodes, LED circuits and applications. This will help students in understanding the basic knowledge of LEDs, their working, and applications. Students will learn how to work in groups and this will improve their analytical skills and problem-solving capability.

Lecture-wise Breakup

Course Code	19B12HS611	Semester : EVEN (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Econometric Analysis		
Credits	3	**Contact Hours**	2-1-0

Faculty (Names)	Coordinator(s)	Manas Ranjan Behera
	Teacher(s) (Alphabetically)	Manas Ranjan Behera

COURSE OUTCOMES		COGNITIVE LEVELS
C304-2.1	*Demonstrate* the key concepts from basic statistics to understand the properties of a set of data.	Understanding Level (C2)
C304-2.2	*Apply* Ordinary Least Square method to undertake econometric studies.	Applying Level (C3)
C304-2.3	*Examine* whether the residuals from an OLS regression are well-behaved.	Analyzing Level (C4)
C304-2.4	*Evaluate* different model selection criteria for forecasting.	Evaluating Level (C5)
C304-2.5	*Create* models for prediction from a given set of data.	Creating Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Statistical Inference	Point and interval estimation; ;The Z distribution ;The Null and Alternate hypotheses ;The chi-square distribution; The F distribution; The t distribution	3

2.	Regression Analysis	Two variable regression model; The concept of the PRF; Classical assumptions of regression; Derivation of the OLS estimators and their variance; Properties of OLS estimators under classical assumptions; Gauss-Markov Theorem; Tests of Hypothesis, confidence intervals for OLS estimators; Measures of goodness of fit: R square and its limitations; Adjusted R square and its limitations	7
3.	Econometric Model Specification	Identification: Structural and reduced form; Omitted Variables and Bias; Misspecification and Ramsay RESET; Specification test; Endogeneity and Bias	5
4.	Failure of Classical Assumptions	Multi-collinearity and its implications; Auto-correlation: Consequences and Durbin-Watson test ;Heteroskedasticity: Consequences and the Goldfeld - Quandt test	2
5.	Forecasting	Forecasting with a)moving averages b) linear trend c) exponential trend CAGR; Forecasting with linear regression; Classical time series decomposition; Measures of forecast performance: Mean square error and root mean square error; Limitations of econometric forecasts	5
6.	Time Series Analysis	Univariate Time Series Models: Lag Operator, ARMA , ARIMA models, Autoregressive Distributed Lag Relationship	3
7.	Linear Programming	Linear programming; Dual of a linear programming problem; Simplex method Transportation	3
		Total number of Lectures	**28**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20

End Semester Examination	35
TA	25 (Quiz+Project+Viva -Voce)
Total	**100**

Project based Learning: Students have to form a group (maximum 5 students in each group) and have to do an econometric analysis on the topic assigned. Students will use the different statistical methods using quantitative data to develop theories or test existing hypothesis. Students will also be encouraged to forecast future economic trends.

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.	Gujarati, D.N. (2002), Basic Econometric (4th ed.), New York: McGraw Hill.
2.	Greene, W.H. (2003), Econometric Analysis, New Jersey: Prentice Hall.
3.	Madala, G.S. (1992), Introduction to Econometrics (2nd ed.), New York: Macmillan.
4.	Wooldridge,J (2010),Econometric Analysis of Cross Section and Panel Data(2nd ed.), Cambridge, The MIT Press.
5.	Stock, J. H., and M. W. Watson. (2015). Introduction to Econometrics, (Third Update), Global Edition. Pearson Education Limited.

Course Code	19B12HS612	Semester:Even	Semester: 6th Session: 2021 -2022
			Month: February – June

Course Name	Social Media and Society		
Credits	3	Contact Hours	2-1-0

Faculty (Names)	Coordinator(s)	Dr. Shirin Alavi
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi

COURSE OUTCOMES		COGNITIVE LEVELS
C304-1.1	Infer the implications of digital change, and the concept of social media and e-marketing in the context of the changing marketing landscape	Applying Level(C3)
C304-1.2	Elaborate the implications of cyber branding and digitization on online marketing mix decisions	Creating Level (C6)
C304-1.3	Develop specific models related to social media and social media analytics	Creating Level (C6)
C304-1.4	Evaluate concepts related to Search Engine Marketing, Customer Centric Web Business models and Web Chain Analysis	Evaluating Level(C5)
C304-1.5	Illustrate the new age marketing practices	Understanding Level (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction, Individuals Online and Rules for engagement for social media	What is social media marketing, the importance of social media for influencing target audience, Patterns of internet usage, Internet user demographics, The BehaviouralInternet, E-Marketing, The Virtual world, the changing Marketing Landscape, E -Marketing- Strengths and Applications, Online Marketing Domains, Digital Marketing Optimization, The Need for Digital Engagement	4
2.	The Online Marketing Mix	The Online Marketing Mix, Consumer Segmentation, Consumer Traits, Consumers and Online Shopping Issues, E-Product, E-Place, E-Price, E-Promotion, Website Characteristics affecting online purchase decision.	3
3.	The Online Consumer and Social Media	The Digital Ecosystem, Online Consumer Behavior, Cultural Implications of key web characteristics, Models of website visits, Web 2.0 and Marketing, The collaborative web, Network evolution, Network science, Marketing with networks, Metcalfe's law, Netnography, Social Media Model by McKinsey, social media Tools-Blogs, Wikis, Online Communities, Facebook, Twitter, You Tube, Flickr, Microblogging.	4

4.	Online Branding and Traffic Building	Cyberbranding, Online brand presence and enhancement, The Digital Brand Ecosystem, Brand Experience, Brand Customer Centricity, Brands and Emotions, The Diamond Water paradox, Internet Traffic Plan, Search Marketing Methods, Internet Cookies and Traffic Building, Traffic Volume and quality, Traffic Building Goals, Search Engine Marketing, Keyword Advertising, Keyword value, Internet Marketing Metrics, Websites and Internet Marketing.	4
5.	Web Business Models ,Social Media Strategy ,Social Media Marketing Plan	The value of a Customer Contact, Customer Centric Business Management, Web Chain of Events, Customer Value Analysis and the Internet, Business Models, Revenue Benefits, Value Uncertainty, Purchase Importance,Define a social media plan, explain the social Media marketing planning cycle, list the 8C's of strategy development.	4
6.	Market Influence analytics in a Digital Ecosystem	Engagement Marketing through Content Management, Online Campaign Management, Consumer Segmentation, Targeting, and Positioning using Online Tools, Market Influence Analytics in a Digital Ecosystem, The Digital Ecosystem, Knowledge as a value proposition, CGM and Consumer behavior, The value of the power of influence, Amplifying Social Media Campaigns.	4
7.	The Contemporary Digital Revolution and its impact on society	Online Communities and Co-creation, The fundamentals of online community management strategies, The World of Facebook, The Future of Social media Marketing—Gamification and Apps, Game based marketing The world of Apps, Apps and the Indian Diaspora	3
8.	Integrating Mobile into Social Media Marketing	Types of Mobile Marketing, Progression of the mobile as a Marketing channel, some Indian mobile marketing campaigns, Impact of social media on government, the economy, development, and education	2
Total number of Lectures			**28**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Project-Report and Viva)
Total	**100**

Project Based Learning: The project is to be done in a group size of 4 -5 members. Students were asked to identify one brand/company on social media. Read the information available on social media and browse through campaigns. Study the consumer engagement and comments. Write their opinion about it. Analyze the same with a social media tool and compare the results. Also identify and elucidate the strategies used by the brand in the context of online branding. This helped the students to understand concepts of cyber branding and social media analytics and enhanced their employability skills in an organization.

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.	Digital Marketing, SeemaGupta,First Edition ,Mc Graw Hill Education (India) Private Limited ,2018
2.	Social Media Marketing A Strategic Approach, Melissa Barker,DonaldBarker,Second Edition Cengage Learning ,2017.
3.	Digital Marketing, Vandana Ahuja, First Edition, Oxford University Press, 2015
4.	Social Media Marketing, Liana "Li" Evans,First Edition , Pearson, 2011.

Detailed Syllabus

Course Code	20B12HS311	Semester Even (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Global Politics		
Credits	3(2-1-0)	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Chandrima Chaudhuri
	Teacher(s) (Alphabetically)	Dr. Chandrima Chaudhuri Dr.Niti Mittal Ms Rashmi Jacobs

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C304-9.1	Demonstrate an understanding of the meaning and nature of globalization by addressing its political, economic, cultural and technological dimensions	UnderstandingLevel (C2)
C304-9.2	Analyzing the significance of contemporary global issues	Analyzing Level (C4)
C304-9.3	Analyze how the global politics shapes domestic politics	Analyzing Level (C4)
C304-9.4	Demonstrate an understanding of the working of the global economy, its anchors and resistances offered by global social movements	Understanding Level(C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Globalization: Conceptions and Perspectives	Political Dimension of globalization Globalization and Culture Technological Dimensions Debates on territoriality and sovereignty	6
2.	Global Economy	Its Significance and Anchors of Global Political Economy:IMF- history and India's benefit from its membership of IMF WTO- History and India's experience with WTO and reform proposals World Bank- history and role of world Bank in India Rise of TNCs and role of TNCs in globalization Global resistances (Global Social Movement and NGOs)- their nature and characteristics , prominent movements and their impact	8
3.	Contemporary Global Issues-I	Ecological Issues: historical overview of international environmental agreements-UNSCD, Paris agreement, climate change- Copenhagen summit to post Copenhagen summit policies of India, climate change and global initiatives	8

		global commons debate	
		Proliferation of Nuclear Weapons-history of nuclear proliferation, threat of proliferation with increase in globalization	
4.	Contemporary Global Issues-II	International Terrorism: globalization and global terrorism, impact of terrorism on globalization, role of non-state actors and state terrorism; the US and war on terrorism Migration and Human Security- globalization, violent extremism and migration; new global regime	6
		Total number of Lectures	**28**

Evaluation Criteria

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

Project Based learning: Each student would form a group of 3-4 students and to make projects on issues such as climate change, terrorism and proliferation of nuclear weapons. This project would help the students in having a better idea about the contemporary global issues and how with the revolution in information and technology as a result of globalization has impacted the world. This would improve their research skills and enhance their knowledge about the impact of globalization on various sectors of the economy.

	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. Hay, Ed. *New Directions in Political Science: Responding to the Challenges of an Interdependent World.* New York, USA: Palgrave Macmillan Education, 2010
2.	D.Held& A. McGrew, *Globalization/Anti-globalization: Beyond the Great Divide*. Cambridge, UK: Polity Press, 2007
3.	F. Halliday, "Terrorism in Historical Perspective".,*Open Democracy*. 22 April, 2004 [Online] Avaliable: http://www.opendemocracy.net/conflict/article_1865.jsp
	H.Shukla, *Politics of Globalization*. Indore, India: Mahaveer Publication, 2021
4.	J. Baylis and S. Smith, Ed.*The Globalization of World Politics: An Introduction to International Relations*. Oxford, UK: Oxford University Press, 2017
5.	L.Gordon and S. Halperin, "Effective Resistance to Corporate Globalisation" in *Contesting Global Governance,* R.O'Brien, A.M. Goetz, J.C. Scholte &M.Williams. Cambridge, UK: Cambridge University Press,2000
	R.Dattagupta, *Global Politics*. Chennai, India: Pearson, 2020

<div align="center">**Course Description**</div>

Course Code	20B12MA311	Semester Even	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Applicational Aspects of Differential Equations		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Shikha Pandey, Dr. Lakhveer Kaur	
	Teacher(s) (Alphabetically)	Dr. Shikha Pandey, Dr. Lakhveer Kaur, Dr. Richa Sharma, Dr. Amit Srivastava	

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C302-2.1	solve ordinary differential equations in LCR and mass spring problems.	Applying Level (C3)
C302-2.2	explain orthogonality of functions and apply it to solve Sturm-Liouville boundary value problems.	Applying Level (C3)
C302-2.3	apply matrix algebra to find the solution of system of linear differential equations.	Applying Level (C3)
C302-2.4	formulate and solve first and second order partial differential equations.	Applying Level (C3)
C302-2.5	evaluate solution of differential equations arising in engineering applications.	Evaluating Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Theory of Ordinary Differential Equations	Existence and uniqueness of solutions, applications to ordinary differential equations in LCR and mass spring problem.	10
2.	Sturm-Liouville Boundary Value Problem	Sturm-Liouville problems, orthogonality of characteristic functions, the expansion of a function in a series of orthogonal functions, trigonometric Fourier series.	10
3.	Matrix Methods to solve ODE's	Matrix method for homogeneous linear systems with constant coefficients.	4
4.	Basic Theory of Partial Differential Equations	Solution of first order equations: Lagrange's equation, Charpit's method, higher order linear equations with constant coefficients.	4
5.	Applications of Differential Equations	Fourier integrals, Fourier transforms, solution of partial differential equations by Laplace and Fourier transform methods, applications of differential equations in mechanics.	14
Total number of Lectures			42

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

Project based learning: Each student in a group of 3-4 will apply the concepts of differential equations arising in engineering applications.

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.	**Ross, S.L.,** Differential Equations, 3rd Ed., John Wiley & Sons, 2004.
2.	**Jain, R.K. and Iyengar, S.R.K.,** Advanced Engineering Mathematics, 3rd Ed., Narosa Publishing House, 2012
3.	**Chandramouli, P.N.,** Continuum Mechanics, Yes Dee Publishing India, 2014.
4.	**Kreysizg, E.,** Advanced Engineering Mathematics, 10th Edition, John Wieley & Sons, Inc. 2013.

Course Code	20B16CS322	Semester Even	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Java Programming		
Credits	Audit	Contact Hours	1-0-2

Faculty (Names)	Coordinator(s)	Dr. Shruti Jaiswal, Ms. Shradha Porwal
	Teacher(s) (Alphabetically)	Dr. Amarjeet Prajapati, Kashav Ajmera, Mr. Prantik Biswas, Dr. Raghu, Ms. Shradha Porwal, Dr. Shruti Jaiswal,

COURSE OUTCOMES At the completion of the course, Students will be able to		COGNITIVE LEVELS
C305-8.1	Write basic Java programs using Java constructs – loops, switch-case and arrays.	Understanding Level (C2)
C305-8.2	Define all basic concepts related to OOP concepts	Remembering Level (C1)
C305-8.3	Develop java programs using Java collection framework	Applying Level (C3)
C305-8.4	Create or design an application based on Java programming constructs	Creating Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Overview of OOA (Object Oriented Analysis) and Java basics	Classes, Objects, OOPs concept using JAVA, Packages and Interfaces.	3
2.	JVM Internals	Memory management, Garbage Collection	1
3.	String Handling	Using String and StringBuilder class. String Immutability(toString())	2
4.	Exception Handling in JAVA	Fundamentals, Exception types, Java built-in exceptions, Custom Exceptions, Chained Exceptions.	2
5.	Collections Framework	Collection Overview, List, Map (hashCode& Equals), Set, Queue & other collections	4
6.	Multithreading in Java	Multithreading overview and requirement, Thread state diagram, Java multithreading implementation (Thread/Runnable), Challenges in	2

		multithreading/Mutual Exclusion, Java handling of mutual exclusion (synchronization), Communication between threads (wait/notify)	
		Total number of Lectures	**14**

Evaluation Criteria

Components	Maximum Marks
Mid Tern Evaluation	30
End Semester Examination	40
TA	30 (Attendance = 07, Quizzes = 08, Internal assessment = 07, Assignments in PBL mode = 08.)
Total	**100**

Project based learning: Assignments on different topics are given to each student. They utilize the java concepts and try to solve different problems given as assignments.The course emphasized on the Skill development of studentsin Java Programming. Topics like inheritance, classes, exception handling,multithreading, collection frameworks, etc. are taught to enhance the programming skills of the students for making them ready for employability in software development companies.

Recommended Reading material:
Text Books
1.   Schildt, H. (2014). *Java: the complete reference*. McGraw-Hill Education Group.
2.   Bloch, J. (2016). *Effective java*. Pearson Education India.
Reference Books
1.   Sierra, K., & Bates, B. (2005). Head First Java: A Brain-Friendly Guide. " O'Reilly Media, Inc.".
2.   Mughal, K. A., & Rasmussen, R. W. (2003). A programmer's guide to Java certification: a comprehensive primer. Addison-Wesley Professional.

Course Code	**20B16CS323**	**Semester** Even	**Semester:** 6th **Session:** 2021 -2022 **Month:** February – June
Course Name	Problem Solving using C and C++		
Credits	**0**	**Contact Hours**	1-0-2

Faculty (Names)	Coordinator(s)	Anuradha Gupta, K Vimal Kumar
	Teacher(s) (Alphabetically)	Anuradha Gupta, Mradula Sharma, K Rajalakshmi, K Vimal Kumar, Prashant Kaushik,

COURSE OUTCOMES		COGNITIVE LEVELS
C350-9.1	Apply and use library functions, pointer arithmetic, arrays, and regular expressions and secure coding practices in programs.	Applying Level (C3)
C305-9.2	Use critical thinking skills and creativity to choose the appropriate containers, iterators and algorithms for a given problem.	Applying Level (C3)
C305-9.3	Demonstrate the use of concurrency principles, input and output streams and defensive techniques in programs.	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Review and practice problems on Functions in C/C++	Functions, Alt function syntax, Function return type deduction, static, const and inline functions, default parameters, overloaded functions- operator and members, friends, overriding functions.	1
2.	Practice problems on Arrays, Pointers and Indirections	Smart pointers, pointers and dynamic memory allocation, type inference, array and pointers and their arithmetic and indirections	2

3.	Secure Coding practices in C/C++	Common String, Integer and dynamic memory allocation Errors, Integer and dynamic memory allocation and String vulnerabilities their mitigation strategies.	2
4.	String Localization and Regular Expression	Localization and working with regular expression, Programming with Regex library	1
5.	Practice problems on Exception Handling and Assertions	Errors and Exceptions, Exception Mechanisms, Exceptions and Polymorphism, Stack unwinding and Cleanup, Common error handling issues	1
6.	Applications with Disk Files and other I/O	Using streams, Input and Output with Streams, String Streams, File Streams and Bidirectional I/O	1
7.	Generic Programming with Templates	Class templates, Function templates, variable templates, Template parameters, Specialization of templates, template recursion, variadic templates, Meta programming	2
8.	Working with Standard Template Library	Understanding and working with containers, container adapters and iterators, Lambda expressions, Function objects, STL algorithms, Customize and extend STL	2
9.	Programming using Dynamic Memory Allocation Model	Working with dynamic memory, array-pointer duality, low level memory operations, smart pointers and common memory pitfalls	1
10.	Problems on Concurrency in Programming	Introduction, Threads, Atomic operations library, Mutual Exclusion, Conditional variables	1
Total number of Lectures			**14**

Evaluation Criteria

Components Maximum Marks
Mid Term Evaluation   30
End Semester Examination   40
TA   30 (Attendance = 07, Quizzes = 08, Internal assessment = 07, Assignments in PBL mode = 08)
Total 100

Project based learning: Project based learning: Each student in a group of 2-4 will choose an industrial application for development. To fulfil the objective of this lab i.e., learning and applying the programming skills in C and C++. Students need to consider a trending industrial requirement for application development

using the programming language skills learned. Understanding programming application development helps the students in enhancing knowledge on industry need of software design and development using programming languages.

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

1	Schildt, H. (2003). C++: The complete reference. McGraw-Hill/Osborne.
2	Lafore, R. (2002). Object-oriented programming in C++. Pearson Education.
3	Deitel, P., & Deitel, H. (2016). C++ how to Program. Pearson.

Recommended Reference Books: Author(s), Title, Edition, Publisher, Year of Publication etc.

1	Savitch, W. J., Mock, K., Msanjila, S., &Muiche, L. (2015). Problem Solving with C++. Pearson.
2	Seacord, R. C. (2005). Secure Coding in C and C++. Pearson Education.
3	Drozdek, A. (2012). Data Structures and algorithms in C++. Cengage Learning.

Course Code	21B12CS311	Semester Even	Semester: 6th Session: 2021 -2022
			Month: February – June
Course Name	Software Development Principles and Practices		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Sarishty Gupta (J62), Chetna Gupta (J128)
	Teacher(s) (Alphabetically)	NA

COURSE OUTCOMES		COGNITIVE LEVELS
C302-13.1	Explain software engineering principles and software process models for project development.	Understanding Level (C2)
C302-13.2	Analyze software requirements and document software requirements specification.	Analyzing Level (C4)
C302-13.3	Design and develop the system models for software development.	Applying Level (C3)
C302-13.4	Apply risk management principles and processes to determine risk and its mitigation plans.	Applying Level (C3)
C302-13.5	Assess software quality using various metrics	Evaluating Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Introduction to Software Engineering**	Introduction to software engineering principles, Software process models (build and fix model, waterfall model, Incremental process model, Evolutionary- Prototype and Spiral models. Introduction to Agile Methodologies, Project planning, and Project Scheduling.	7
2.	**Requirement Engineering**	Balancing Development Needs with Organizational Expectations, Writing Requirements and Requirements Specifications, Quality Assurance of Requirements, Types of requirement, Prioritizing Requirements, SRS.	7
3.	**Software Design**	Use case diagram, State diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Component Diagram and Package diagram. Design Modularity: Coupling Cohesion.	8
4.	**Risk Assessment and management**	Task Analysis, Accident Theory, Accident Investigation and Reporting, Accident Statistics, Safety Inspection Procedures, Disaster Planning, Risk Management Systems, Analysis of risk at various stages of SDLC, Tools and techniques	5
5.	**Software Metrics**	Size-Oriented Metric, Functional Point metric, Function-oriented Metric, Halstead's Software Metric, Information Flow Metric, Object oriented Metric, Class-Oriented Metric, COCOMO Model.	6
6.	**Software Testing and Debugging**	White-Box Testing, Basis Path Testing, Control Structure Testing: Condition Testing, Data Flow Testing, Loop	9

		Testing, Black-Box Testing: Equivalence class partitioning, Boundary Value Analysis, Decision table testing, Cause effect graphing, Mutation Testing and regression Testing. Debugging and its types.	
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (**Attendance-05, Assignments/Quiz/Mini Project-20**)
Total	**100**

Project based learning: Each student in a group of 4-5 will choose an application or problem Software Development Principles to understand the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment. To make subject application based, the students demonstrate an understanding of current theories, models, and techniques that provide a basis for the software lifecycle. Expose students to current technologies and issues that provide ability to use the techniques and tools necessary for engineering practice and employability into software industries.

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.	Roger S. Pressman and Bruce R Maxim, "Software Engineering: A practitioner approach", 8thEdition-McGraw-Hill - ISBN: 978-0-07-802212-8
2.	Sommerville , "Software Engineering" , Seventh Edition - Addison Wesley
Other Reference books	
3.	GRADYBOOCH, JAMES RUMBAUGH, IVAR JACOBSON, The Unified Modeling Language User Guide, Addison Wesley, Reading, Massachusetts.
4.	Richard Thayer , "Software Engineering Project Management", Second Edition - Wiley-IEEE Computer Society Press.
5.	B. Bezier, "Software Testing Techniques", Second Edition- International Thomson Computer Press.
6.	Pankaj Jalote, "An Integrated Approach to Software Engineering" Third addition , Springer Press

DETAILED SYLLABUS AND EVALUATION SCHEME

CourseCode	21B12HS311	Semester:EVEN (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June
CourseName	Development Issues and Rural Engineering		
Credits	03	ContactHours	2-1-0

Faculty(Names)	Coordinator(s)	Dr.Amandeep Kaur
	Teacher(s) (Alphabetically)	Dr. Amandeep Kaur amandeep.kaur@mail.jiit.ac.in

COURSE OUTCOMES		COGNITIVE LEVELS
C304-10.1	Understand the concept, philosophy and determinants of rural development	Understanding Level(C2)
C304-10.2	Assess public policies related to rural development	Analyzing Level (C4)
C304-10.3	Explain the role of local self-governance in planning and development of rural areas.	Understanding Level (C2)
C304-10.4	Analyze the impact of recent policy changes and schemes on rural development.	Analyzing Level (C4)
C304-10.5	Evaluate the issue and challenges of through possible determinants of rural development.	Evaluating Level(C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Rural Development: An Introduction	Rural Development Philosophy, Concepts, Principles, Traditional and Modern Concept of Development, Trends and Pattern of micro as well as macro indicators of Rural Development.	4
2.	Public Policies and Rural Development	Policies related to Employment Generation, Poverty Reduction, Skill Development and, Infrastructure such as MGNGEGA, DDUGKY, Atam Nirbhar Bharat rojgaryojna and schemes related to MSMEs etc.	6
3.	Rural Development Administration and Panchayat Raj Institutions	Rural Development administration: Panchayat Raj System (73rd Amendment Act), functions of Panchayat Raj System, Financial Distribution of Resources in Rural India through Panchayat Raj System, merits and demerits of Panchayat system, Ways to strengthen the existing system by overcoming the flaws.	6

4.	Rural Development Issues and Challenges	Issues and challenges of Rural development: Employment in line with sectoral distribution (GDP and Employment), Poverty and Migration Issue, Rural and Urban Consumption and Production Linkages.	7
5.	Recent Advancements and changes	Recent packages and schemes implemented in Rural India, Budget Allocation for Rural Development -2019-20 and 2020-21: For Employment Generation, poverty reduction, infrastructure and MSMEs.	5
Total number of Lectures			**28**

Evaluation Criteria

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

Project-based Learning: Students are required to collect the data related to different indicators of rural development (related to agriculture, health and education infrastructure, literacy levels, population density, poverty, employment etc.). They also need to check the compatibility of data (data mining and data refining process) and then analyse the contribution of these indicators in rural development of particular state/country as whole. Moreover, they are required to analyse the extent of progress and failure of programmes/schemes implemented in rural areas for poverty reduction, employment generation and MSMEs. Collecting information and analysing the data related to development indicators and policies will upgrade students' knowledge regarding the development issues and strengthen their skills to tackle multiple data handling and measuring issues.

Recommended Reading material:	
1.	**Singh, Katar.** Rural Development: Principles, Policies and Management *(3e).*2009
2.	**Coke, P., Marsden, T. and Mooney, P.** Handbook of Rural Studies. Sage Publications, 2006
3.	**Todaro, M.P**., **Stephen C. Smith,** Economic Development, Pearson Education, 2017
3.	**Ahuja, H. L.**, Development Economics, S Chand publishing, 2016
4.	**Musgrave, R. A., Musgrave, P. B.,** Public Finance in Theory and Practice, McGraw Hill Education,2017

Course Code	21B13HS311	Semester Even (specify Odd/Even)	Semester: 6th Session: 2021 -2022 Month: February – June
Course Name	Poverty, Inequality and Human Development		
Credits	2	Contact Hours	1-0-2

Faculty (Names)	Coordinator(s)	Dr Akarsh Arora
	Teacher(s) (Alphabetically)	Dr Akarsh Arora

COURSE OUTCOMES		COGNITIVE LEVELS
C304-12.1	Understand the concepts and dimensions of Poverty, Inequality and Human Development	Understanding Level (C2)
C304-12.2	Evaluate different approaches to measure Poverty, Inequality and Human Development	Evaluating Level (C5)
C304-12.3	Apply an analytical framework to understand the factual or proximate causes or determinants of Poverty and Inequality	Applying Level (C3)
C304-12.4	Analyze the role of public policy and affirmative action to tackle Poverty and Inequality and strengthen Human Development.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Concepts and Dimensions	Concepts and Dimensions of Poverty, Inequality and Human Development	3
2.	Measurement	Measurement of Poverty and Inequality: Steps and Axioms. Steps to calculate Human Development	4
3.	Data Sources	Census Data, Unit level Household Data, Geospatial Data, Satellite Image Data	2
4.	Determinants	Determinants/ Factors: Demographics, Household, Individual, and Macroeconomic variables Introduction to Stata, Regression- Linear and Binary models	3
5.	Public Policies and Affirmative Actions	Review of different public policies of GOI to eradicate poverty. Role of education and health care policies to strengthen human development	2
		Total number of Lectures	**14**

Module No.	Title of the Module	List of Experiments/Activities	CO
1.	Concepts and Dimensions	Practical sessions on different dimensions of poverty and inequality.	CO1, CO2
2.	Measurement	Practical sessions on STATA software to measure poverty, inequality, and human development.	CO1, CO2
3.	Data Sources	Practical sessions on key survey issues and problems while collecting data on poverty, inequality and human	CO2, CO3

		development.	
4.	Determinants	Practical sessions on STATA software to find and interpret the determinants of poverty using regression analysis.	CO2, CO3
5.	Public Policies and Affirmative Actions	Practical sessions on the impact of different Government of India policies and programmes on poverty, inequality and human development.	CO3, CO4

Project based Learning: Students, in groups of 2-3, are required to submit a detailed report on the measurement of poverty and inequality for the selected Indian state. Students are expected to follow official poverty estimation reports in India and measure poverty in a genuine sense based on the existing poverty methodology. They also need to check the data's compatibility, process the data after cleaning for various issues and analyse poverty and inequality at aggregated and disaggregated levels. Furthermore, they need to support findings/ arguments based on previous research studies. Measurement, interpretation and empirical-based argumentation in this sense will upgrade students' knowledge regarding economic development issues and strengthen their skills to tackle extensive and multiple data sets and develop their core competencies in respect of social data science.

Evaluation Criteria
Components   **Maximum Marks**
Mid Term   30 (Project)
End Term   40 (Written)
TA   30 (Project Assignment, Quiz)
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.	A. V. Banerjee and E. Duflo, *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York: Public Affairs, 2011
2.	J. Haughton and S. R. Khandker, *Handbook on Poverty and Inequality*. Washington, DC: The World Bank, 2009.
3.	A. Tarozzi and A. Deaton, "*Using census and survey data to estimate poverty and inequality for small areas*," The review of economics and statistics, vol. 91, no. 4, pp. 773-792, 2009.
4.	D. Ray, *Development Economics*, 19 ed. New Delhi, India: Oxford University Press, 2012
5.	A. Sen, *On Economic Inequality*. Oxford: Clarenson Press, 1997.
6.	S. Alkire and M. E. Santos, "*Acute Multidimensional Poverty: A New Index for Developing Countries*," OPHI Working Paper. 2017.
7.	A. V. Banerjee and E. Duflo, *Good Economics for Hard Times*. New Delhi: Juggernaut, 2019.

Course Description

Subject Code	18B12MA612	Semester Even	Semester: 6th Session: 2021 -2022 Month: February – June
Subject Name	Applied Mathematical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr Vipin Chandra Dubey	
	Teacher(s) (Alphabetically)	DrNisha Shukla, Dr Vipin Chandra Dubey	

COURSE OUTCOMES		
After pursuing the above mentioned course, the students will be able to:		**COGNITIVE LEVELS**
C302-4.1	explain the functional and its variations required to optimize the physical problem.	Understanding Level (C2)
C302-4.2	apply different forms of Euler–Lagrange equation on the various variational problems with fixed boundaries.	Applying Level (C3)
C302-4.3	explain different types of integral equations including their conversions from IVP and BVP.	Understanding Level (C2)
C302-4.4	solve Volterra and Fredholm integral equations using various analytical methods.	Applying Level (C3)
C302-4.5	explain various numerical methods along with their stability analysis.	Understanding Level (C2)
C302-4.6	apply different numerical methods for solving differential equations.	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Functional and its Variation	Introduction, problem of brachistochrone, problem of geodesics, isoperimetric problem, variation and its properties, comparison between the notion of extrema of a function and a functional.	8
2.	Variational Problems with Fixed Boundaries	Euler's equation, the fundamental lemma of the calculus of variations, examples, functionals in the form of integrals, special cases contaning only some of the variables, examples, functionals involving more than one dependent variables and their first derivatives, the system of Euler's equations,	5
3.	Variational Problems (continued)	Functionals depending on the higher derivatives of the dependent variables, Euler- Poisson equation, functionals containing several independent variables, Ostrogradsky equation, Variational problems in parametric form, applications to differential equations.	5
4.	Fredholm and Volterra Integral Equations	Introduction and basic examples, Classification, Conversion of Volterra Equation to ODE, Conversion of IVP and BVP to integral equation, decomposition, direct computation, successive approximation, successive substitution methods for Fredholm and Volterra integral equations.	8
5.	Numerical Methods I	Classification of PDEs, Finite difference approximations to partial derivatives. Solution of one	8

		dimensional heat conduction equation by Explicit and Implicit schemes (Schmidt and Crank Nicolson methods), stability and convergence criteria.	
6.	Numerical Methods II	Laplace equation using standard five point formula and diagonal five point formula, Poisson equation, Iterative methods for solving the linear systems. Hyperbolic equation, explicit / implicit schemes, method of characteristics. Solution of wave equation. Solution of I order Hyperbolic equation. Von Neumann stability.	8

Total number of Lectures		**42**

Evaluation Criteria

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

Project based learning: Students will be divided in the group of 4-5 students to collect the literature and explore the different numerical methods to solve partial 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.	**Hilderbrand, F.B.,** Methods of Applied Mathematics, 2ndEdition, Prentice Hall, 1969.
2.	**Gupta, A.S.,** Calculus of Variations with Applications, Prentice Hall of India, 2003.
3.	**Gelfand, I.M.,** Fomin, S.V. Calculus of Variations, Prentice Hall, 1963.
4.	**Elsgolts, L.,** Differential Equations and the Calculus of Variations, Mir Publishers, Moscow, 1973.
5.	**Petrovsky, I.G.,** Lectures on the Theory of Integral Equations, Mir Publishers, Moscow, 1971.
6.	**Smith, G. D.**., Numerical solution of partial differential equations: finite difference methods. Oxford University Press, 1985