NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

Evaluation Scheme & Syllabus

For

Bachelor of Technology

Electronics and Communication & Engineering

Third Year

(Effective from the Session: 2025-26)

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)
Bachelor of Technology
Electronics and Communication Engineering
Evaluation Scheme
SEMESTER-V

Sl. No.	Subject Codes	Subject	Types of Subjects	Periods		Evaluation Schemes					End Semester		Total	Credit
				L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BEC0501	Electromagnetic Field Theory and Antenna	Mandatory	3	1	0	30	20	50		100		150	4
2		Departmental Elective-I	Departmental Elective	3	0	0	30	20	50		100		150	3
3		Departmental Elective-II	Departmental Elective	3	0	0	30	20	50		100		150	3
4	BCSCC0501	Design Thinking –II	Mandatory	2	1	0	30	20	50		100		150	3
5	BEC0551	Wireless Communication	Mandatory	0	0	6				50		100	150	3
6	BEC0552	Computer Networks	Mandatory	0	0	6				50		100	150	3
7		Department of Elective Lab	Departmental Elective	0	0	4				50		50	100	2
8	BEC0559	Internship Assessment	Mandatory	0	0	2				50			50	1
9	BNC0502/ BNC0501	Essence of Indian Traditional Knowledge/ Constitution of India	Compulsory Audit	2	0	0	30	20	50		50			NA
10		MOOCs (Essential for Hons. Degree)												
		TOTAL		**13**	**2**	**18**	**120**	**80**	**200**	**200**	**400**	**250**	**1050**	**22**

*** List of MOOCs Based Recommended Courses for Third year (Semester-V) B. Tech Students**

Sr. No.	Subject Code	Course Name	University / Industry Partner Name	No of Hours	Credits
1	BMC0070	C on Linux	Infosys Wingspan (Infosys Springboard)	10h 20m	0.5
2	BMC0104	Wireless Evolution and 4G LTE Overview	Infosys Wingspan (Infosys Springboard)	52h 4m	4

PLEASE NOTE: -

- **A 3-4 weeks Internship shall be conducted during summer break after semester-IV and will be assessed during semester-V**
- **Compulsory Audit (CA) Courses (Non-Credit - BNC0502/ BNC0501)**
  - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - The total and obtained marks are not added in the grand total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

List of Departmental Electives

Sr. No.	Subject Codes	Subject Name	Departmental Electives	Bucket Name
1	BEC0511	Embedded System Design	Departmental Elective-I	Embedded & Robotics
2	BEC0513	Introduction to Robotics and it's Applications	Departmental Elective-II	
3	BEC0511 P	Embedded System Design Lab	Departmental Elective	
4	BEC0512	Machine Learning	Departmental Elective-I	Artificial Intelligence
5	BEC0514	Artificial Intelligence	Departmental Elective-II	
6	BEC0512 P	AI & ML Lab	Departmental Elective	
7	BEC0511	Embedded System Design	Departmental Elective-I	Embedded and VLSI
8	BEC0515	VLSI Technology	Departmental Elective-II	
9	BEC0511 P	Embedded System Design Lab	Departmental Elective	

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SEMESTER-VI

Sl. No.	Subject Codes	Subject	Types of Subjects	Periods			Evaluation Schemes				End Semester		Total	Credit
				L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BEC0601	5G Technology	Mandatory	3	1	0	30	20	50		100		150	4
2		Departmental Elective-III	Departmental Elective	3	0	0	30	20	50		100		150	3
3		Departmental Elective-IV	Departmental Elective	3	0	0	30	20	50		100		150	3
4		Open Elective-I	Open Elective	3	0	0	30	20	50		100		150	3
5	BEC0651	IoT Architecture and Protocols	Mandatory	0	0	6				50		100	150	3
6	BEC0652	Digital Signal Processing	Mandatory	0	0	6				50		100	150	3
7		Departmental Elective Lab	Departmental Elective	0	0	2				25		25	50	1
8	BEC0659	Minor Project	Mandatory	0	0	6				50		100	150	3
9	BNC0601/ BNC0602	Constitution of India / Essence of Indian Traditional Knowledge	Compulsory Audit	2	0	0	30	20	50		50			
		MOOCs (Essential for Hons. Degree)	MOOCs											
		TOTAL		**14**	**1**	**20**	**120**	**80**	**200**	**175**	**400**	**325**	**1100**	**23**

*** List of MOOCs Based Recommended Courses for Third year (Semester-VI) B. Tech Students**

Sr. No.	Subject Code	Course Name	University / Industry Partner Name	No of Hours	Credits
1	BMC0076	Data Structures and Algorithms	Infosys Wingspan (Infosys Springboard)	18h 5m	1
2	BMC0082	Introduction to AI & ML	Infosys Wingspan (Infosys Springboard)	64h 13m	4
3	BMC0103	Wireless 5G Overview	Infosys Wingspan (Infosys Springboard)	55h 44m	4

PLEASE NOTE: -

- **A 3-4 weeks Internship shall be conducted during summer break after semester-VI and will be assessed during Semester-VII**
- **Compulsory Audit (CA) Courses (Non-Credit - BNC0601/ BNC0602)**
  - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - The Total and obtained marks are not added in the Grand Total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

List of Departmental Electives

Sr. No.	Subject Codes	Subject Name	Departmental Electives	Bucket Name
1	BEC0611	Control System and Automation	Departmental Elective-I	Embedded & Robotics
2	BEC0614	Robotics Design Mechanism	Departmental Elective-II	
3	BEC0614P	Robotics Lab	Departmental Elective	
4	BEC0612	Image Processing and Pattern Recognition	Departmental Elective-I	Artificial Intelligence
5	BEC0615	ANN & Deep Learning	Departmental Elective-II	
6	BEC0612P	Image Processing and Pattern Recognition Lab	Departmental Elective	
7	BEC0613	VLSI Testing and Reliability	Departmental Elective-I	Embedded and VLSI
8	BEC0616	Real Time Operating System	Departmental Elective-II	
9	BEC0616P	Real Time Operating System Lab	Departmental Elective	

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A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Coursera certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

1. For 6 to 12 Hours =0.5 Credit
2. For 13 to18 =1 Credit
3. For 19 to 24 =1.5 Credit
4. For 25 to 30 =2 Credit
5. For 31 to 35 =2.5 Credit
6. For 36 to 41 =3 Credit
7. For 42 to 47 =3.5 Credit
8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Coursera registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only. The students shall be awarded Honours Degree as per following criterion.

i. If he / she secures 7.50 as above CGPA.
ii. Passed each subject of that degree program in the single attempt without any grace.
iii. Successful completion of MOOCs based 20 credits

Bachelor of Technology Third Year			
Course Code	**BEC0501**	**L T P**	**Credits**
Course Title	**Electromagnetic Field Theory and Antenna**	**3 1 0**	**4**

Course Objectives: The student will learn about

Concept of electromagnetic field theory, starting with an exploration of various coordinate systems and the application of vector calculus in describing static electric and magnetic fields. By delving into Maxwell's equations for time-varying fields and examining wave propagation in different mediums, students will gain insights into the fundamental principles governing electromagnetic phenomena. Pointing's theorem will elucidate the energy flow in electromagnetic radiation, while exploration of basic antenna properties will provide a foundation for understanding practical antennas and their diverse applications in modern communication systems.

Pre- requisites: Basic Vector Algebra

Course Contents / Syllabus

UNIT-I	**Coordinate Systems and Transformation**	**8 hours**

Coordinates transformation: Cartesian, Cylindrical and Spherical. Vector calculus: Differential length, area and volume, line, surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar

UNIT-II	**Electrostatic fields and Magnetostatic fields**	**8 hours**

Electric field intensity, Electric field due to charge distribution, Electric flux density, Gauss's Law, Maxwell's equations, Continuity equation and relaxation time, boundary conditions, Magnetostatic fields, Ampere's circuit law, Maxwell's equation, magnetic scalar and vector potential, Magnetic boundary conditions

UNIT-III	**Electromagnetic waves**	**8 hours**

Maxwell's equations in final form, plane wave propagation in different medium: lossy dielectrics, lossless dielectrics, free space and good conductor, wave polarization, Poynting's theorem, radiation from small current element, power density and radiation resistance of short electric dipole and half wave dipole.

UNIT-IV	**Antenna fundamental**	**8 hours**

Introduction, Basic antenna parameters, Patterns, Beam area, Radiation intensity, Beam efficiency, Directivity and Gain, Directivity and resolution, Antenna apertures, Effective height, The radio communication link.

UNIT-V	**Practical Antennas**	**8 hours**

The Loop Antenna, Design and its Characteristic, Application of Loop Antennas. Horn Antennas, Helical Antennas, The Log-Periodic Antenna, Design of Microstrip Antenna, Parabolic Reflector Antennas, Feed Methods for Parabolic Reflectors.

Course Outcomes: At the end of this course students will demonstrate the ability to	**Bloom's Knowledge Level(KL)**

CO 1	Apply different coordinate systems and vector calculus to solve problems of electromagnetic fields	K3, K4
CO 2	Explain and apply the concepts of static Electric and Magnetic fields.	K2, K3
CO 3	Explain Maxwell's equations and their applications.	K2, K3
CO 4	Explain and calculate the fundamental properties of Antenna..	K2, K4
CO 5	Analyze practical Antennas with applications.	K2, K3

Text books:

1. MNO Sadiku, "Elements of Electromagnetics', Oxford University Press, 2014.
2. John D Kraus, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", Fourth Edition, Tata McGraw Hill, 2011.
3. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 2016.

Reference Books:

1. W H Hayt and JA Buck, "Engineering Electromagnetics", McGraw- Hill Education, 2013.
2. A. R. Harish, M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press, 2007.
3. R. L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi, 2018.
4. A. Das, Sisir K. Das, "Microwave Engineering", Tata McGraw Hill, 2001.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=3qd1JT7sRG8
Unit II	https://www.youtube.com/watch?v=F5KFYBdjzuE&list=PLVFqK_9GOGXnV8fwd2YmU
Unit III	https://www.youtube.com/watch?v=7NZhmOIyYQM
Unit IV	https://www.youtube.com/watch?v=h51mFbIgZRI&list=PLbRMhDVUMngfytbQXzasPM
Unit V	https://www.youtube.com/watch?v=wx_tIvaajAI&list=PL3UZlxOnyu9CRoBFsG5x-VqYeC69FmMZT

Bachelor of Technology Third Year			
Course Code	**BEC0503**	**L T P**	**Credits**
Course Title	**Design Thinking -II**	**2 1 0**	**3**

Course Objectives: The student will learn about

The Design Thinking skills by learning & applying advanced and contextual Design Thinking Tools. It aims to solve a Real-Life Problem by applying Design Thinking to create an impact for all the stakeholders.

Pre-requisites: Student must complete Design Thinking-I course

Course Contents / Syllabus

UNIT-I	**Introduction**	**8 hours**

Design thinking & Innovation, Design Thinking Mindset and Principles, recap of 5-Step Process of Design Thinking, Design Approaches, additional in-depth examples of each design approaches. Simon Sinek's – Start with Why, The Golden Circle, Asking the "Why" behind each example *(an in-class activity of asking 5-WHYS),* The Higher Purpose, *in-class activity for LDO & sharing insight.*

Visualization and its importance in design thinking, reflections on wheel of life (*in-class activity for visualization & Wheel of Life*), Linking it with Balancing Priorities (*in class activity),* DBS Singapore and Bank of Americas' Keep the Change Campaign. Litter of Light & Arvind Eye Care Examples, understanding practical application of design thinking tools and concepts, case study on McDonald's Milkshake / Amazon India's Rural Ecommerce & Gillette.

Working on 1-hour Design problem, Applying RCA and Brainstorm on innovative solutions. Main project allocation and expectations from the project

UNIT-II	**Refinement and Prototyping**	**8 hours**

Refine and narrow down to the best idea, 10-100-1000gm, QBL, Design Tools for Convergence – SWOT Analysis for 1000gm discussion. *In-class activity for 10-100-1000gm & QBL.*

Prototyping (Convergence): Prototyping mindset, tools for prototyping – Sketching, paper models, pseudo-codes, physical mockups, Interaction flows, storyboards, acting/role-playing etc, importance of garnering user feedback for revisiting Brainstormed ideas, Napkin Pitch, Usability, Minimum Viable Prototype, Connecting Prototype with 3 Laws, A/B Testing, Learning Launch. Decision Making Tools and Approaches – Vroom Yetton Matrix, Shift-Left, Up, Right, Value Proposition, Case study: Career buddy, You-Me-Health Story & IBM Learning Launch.

In-class activities on prototyping- paper-pen / physical prototype/ digital prototype of project's 1000gm idea

UNIT-III	**Storytelling, Testing and Assessment**	**8 hours**

Storytelling: Elements of storytelling, Mapping personas with storytelling, Art of influencing, Elevator Pitch, Successful Campaigns of well- known examples, *in-class activity on storytelling.*

Testing of design with people, conducting usability test, testing as hypothesis, testing as empathy, observation and shadowing methods, Guerrilla Interviews, validation workshops, user feedback, record results, enhance, retest, and refine design, Software validation tools, design parameters, alpha & beta testing, Taguchi, defect classification, random sampling.

Final Project Presentation and assessing the impact of using design thinking

UNIT-IV	**Innovation, Quality and Leadership**	**8 hours**

Innovation: Need & Importance, Principles of innovations, Asking the Right Questions for innovation, Rationale for innovation, Quality: Principles & Philosophies, Customer perception on quality, Kaizen, 6 Sigma. *FinTech case study of Design Thinking application – CANVAS* Leadership, types, qualities and traits of leaders and leadership styles, Leaders vs Manager, Personas of Leaders & Managers, Connecting

Leaders-Managers with 13 Musical Notes, Trait theory, LSM (Leadership Situational Model), Team Building Models: Tuckman's and Belbin's. Importance of Spatial elements for innovation

UNIT-V	**Understanding Human Desirability**	**8 hours**

Program needed to achieve the comprehensive human goal: the five dimensions of human endeavor (Manaviya Vyavstha) are: Education- Right living (Sikhsa- Sanskar), Health – Self-regulation (Swasthya Sanyam), Justice – Preservation (Nyaya- Suraksha), Production – Work (Utpadan – Karya), Exchange – Storage (Vinimya – Kosh), Darshan-Gyan-Charitra (Shifting the Thinking).

Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Thinking expansion for harmony: Self-exploration (Johari's window), group behaviour, interpersonal behaviour and skills, Myers-Briggs personality types (MBTI), FIRO-B test to repair relationships.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Learn sophisticated design tools to sharpen their problem-solving skills	K2
CO 2	Generate innovate ideas using design thinking tools and converge to feasible idea for breakthrough solution.	K3, K4
CO 3	Implement storytelling for persuasive articulation	K3
CO 4	Understanding the nature of leadership empowerment	K2
CO 5	Understand the role of a human being in ensuring harmony in society and nature.	K2

Text books:

1. Arun Jain, UnMukt : Science & Art of Design Thinking, 2020, Polaris
2. Gavin Ambrose and Paul Harris, Basics Design 08: Design Thinking, 2010, AVA Publishing SA
3. R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, First Edition, 2009, Excel Books: New Delhi

Reference Books:

1. Jeanne Liedta, Andrew King and Kevin Benett , Solving Problems with Design Thinking – Ten Stories of What Works, 2013, Columbia Business School Publishing.
2. Dr RituSoryan, Universal Human Values and Professional Ethics, 2022, Katson Books.
3. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey.
4. Roger L. Martin, Design of Business: Why Design Thinking is the Next Competitive Advantage, 2009, Harvard Business Press, Boston MA.
5. Tim Brown, Change by Design, 2009, Harper Collins.
6. Pavan Soni, Design your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, 2020, Penguin Books.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=6_mHCOAAEI8 https://nptel.ac.in/courses/110106124 https://designthinking.ideo.com/ https://blog.experiencepoint.com/how-mcdonalds-evolved-with-design-thinking
Unit II	https://www.coursera.org/lecture/uva-darden-design-thinking-innovation/the-ibm-story-iq0kE

	https://www.coursera.org/lecture/uva-darden-design-thinking-innovation/the-meyouhealth-story-part-i-what-is-W6tTs https://onlinecourses.nptel.ac.in/noc19_mg60/preview
Unit III	https://nptel.ac.in/courses/109/104/109104109/ https://www.d-thinking.com/2021/07/01/how-to-use-storytelling-in-design-thinking/
Unit IV	https://www.worldofinsights.co/2020/10/infographic-8-design-thinking-skills-for-leadership-development/
Unit V	https://www.youtube.com/watch?v=hFGVcx1Us5Y

Bachelor of Technology Third Year

Course Code	BEC0511	L T P	Credits
Course Title	Embedded System Design	3 0 0	3

Course Objectives: The student will learn about		Bloom Level
1	Understand the basic introduction to embedded system design requirements.	K1
2	Learn the STM32F401 board & its interfacing.	K2
3	Understand the Architecture of ARM CORTEX-M4 processor.	K2
4	Learn the programming techniques of ARM processor.	K3
5	Understand the concept of embedded Linux and Linux kernel architecture.	K2

Pre-requisites: Knowledge of Microprocessor and Microcontroller

Course Contents / Syllabus

UNIT-I	Introduction to Embedded Systems	8 hours

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Design Considerations of Embedded Systems.

UNIT-II	STM32F401	8 hours

STM32F401 Nucleo Board, Interfacing with Analog World, Output Devices, Sensors and Actuators, Interfacing with 7 segment LED and LCD Displays, Interfacing with Temperature Sensor and LDR Light Sensor, Speed Control of DC Motor.

UNIT-III	Arm Architectures and Processors	8 hours

Key features of Arm architectures and processors, Structure and purpose of specific registers in the Arm Cortex-M4 processor, Interrupts: Nested Vectored Interrupt Controller (NVIC), Wakeup Interrupt Controller (WIC), Memory Protection Unit (MPU), Bus Interconnect and Debug System and Low Power Features.

UNIT-IV	Introduction to Arm Cortex	8 hours

M4 Programming, Compare the C and Assembly programming languages, C as Implemented in Assembly Language, Benefits and drawbacks of high-level and low-level programming, Introduction to the Mbed Platform and CMSIS, Mbed platform and its importance

UNIT-V	History of Embedded Linux	8 hours

Embedded Linux versus Desktop Linux, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel Architecture, Linux Start-Up Sequence, GNU Cross-p\Platform Tool chain, Linux Serial Driver, Ethernet Driver.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Compute the design considerations of embedded systems.	K1, K2
CO 2	Apply the knowledge to learn STM32F401 for various application.	K1, K3, K4
CO 3	Analyze the Architecture of ARM CORTEX-M4 processor.	K3, K4
CO 4	Implement the programming techniques for ARM processor.	K3, K4

CO 5	Evaluate the concept of embedded Linux and kernel architecture.	K2, K4, K5
Text books:		
1. ARM system developers guide, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier,Morgan Kaufman publishers, 2008.		
2. The Definitive Guide to the ARM Cortex-M3, by Joseph Yiu, 2nd Edition, Newnes, 2009		
3. Embedded Linux System Design and Development, P.Raghavan, Amol Lad, Sriram		
Reference Books:		
1. Shibu K V, ―Introduction to Embedded Systems‖, Tata McGraw Hill Education Private Limited, 2009.		
2. Embedded Systems: Architecture, Programming and design, Raj Kamal, Second Edition, Tata McGraw Hill publisher, 2010.		
3. David E. Simon, "An Embedded Software Primer", Pearson Education.		
4. ARM System-on-Chip Architecture, Steve Furber, Second Edition, Pearson, 2015		
NPTEL/ YouTube/ Faculty Video Link:		
Unit I	https://www.youtube.com/watch?v=y9RAhEfLfJs	
Unit II	https://www.youtube.com/watch?v=C04ZthY8Yqk	
Unit III	https://nptel.ac.in/courses/106/105/106105193/	
Unit IV	https://www.youtube.com/watch?v=csttt3VHxf8	
Unit V	https://www.youtube.com/watch?v=h-ZP98qhEM8	

Bachelor of Technology Third Year			
Course Code	**BEC0513**	**L T P**	**Credits**
Course Title	**Introduction to Robotics and it's Applications**	**3 0 0**	**3**

Course Objectives: The student will learn about		**Bloom Level**
1	The concept of robotics.	K1
2	Mathematical relations for forward and inverse kinematic analysis.	K2
3	The various types of actuators and drive systems.	K1
4	Different types of sensors for a robot in a specific job task.	K3
5	The applications of robotics in industry.	K2

Pre-requisites: Engineering mechanics, Basic Electrical & Electronics, Sensor & Instrumentation

Course Contents / Syllabus

UNIT-I	**Introduction to Robotics**	**8 hours**

Classification of Robots, Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages.

UNIT-II	**Mechanics in Robotics**	**8 hours**

Position Analysis – Introduction, Robots as Mechanisms, Conventions, Matrix Representation Homogeneous Transformation Matrices, Representation of Transformations Forward and Inverse Kinematics of Robots, Forward and Inverse Kinematics of Planar Parallel Robots.

UNIT-III	**Introduction to Actuating System**	**8 hours**

Introduction, Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors Microprocessor Control of Electric Motors, Pulse Width Modulation, Direction Control of DC Motors with an H-Bridge, Speed Reduction.

UNIT-IV	**Sensors**	**8 hours**

Introduction, Sensor Characteristics, Sensor Utilization, Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Pressure Sensors Torque Sensors, Micro-switches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors, Range Finders, Sniff Sensors.

UNIT-V	**Robotics Applications**	**8 hours**

Robotics applications in Manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation. Limitation of usage of robots in processing operation.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Explain the concept of robotics.	K2
CO 2	Formulate the mathematical relations for forward and inverse kinematic analysis.	K2
CO 3	Interpret the various types of actuators and drive systems.	K6
CO 4	Explain the different type's sensor for a robot in a specific job task.	K5
CO 5	Describe the applications of robotics in industry.	K3

Text books:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotic Engineering - An Integrated Approach: Richard D. Klafter Thomas A.
3. Robotics for Engineers, by Y. Koren, McGraw Hill.

Reference Books:

1. Saeed B. Niku, "Introduction to Robotics – Analysis, Systems and Application" : PHI 2006.
2. J.J. Craig, Robotics, Addison-Wesley, 1986.
3. K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 1987.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=y9RAhEfLfJs
Unit II	https://www.youtube.com/watch?v=C04ZthY8Yqk
Unit III	https://nptel.ac.in/courses/106/105/106105193/
Unit IV	https://www.youtube.com/watch?v=csttt3VHxf8
Unit V	https://www.youtube.com/watch?v=h-ZP98qhEM8

Bachelor of Technology Third Year			
Course Code	**BEC0512**	**L T P**	**Credits**
Course Title	**Machine Learning**	**3 0 0**	**3**
Course Objectives: The student will learn about			
The machine learning, basics of statistics, neural networks, dimensionality reduction, various search, optimization and learning techniques.			
Pre-requisites: Basics of mathematics and python programming			
Course Contents / Syllabus			
UNIT-I	**Introduction to Machine Learning**		**8 hours**
Supervised Learning, Unsupervised Learning, Reinforcement Learning and hypothesis testing. Probability Basics, Linear Algebra, Statistical Decision Theory – Regression & Classification, Bias – Variance, Linear Regression, Multivariate Regression.			
UNIT-II	**Neural Networks**		**8 hours**
Hebb's Rule, McCulloch and Pitts Neurons, Limitation of McCulloch and Pitts Neurons, The Perceptron, Linear separability, Linear Regression, Back propagation algorithm. The Multi-Layer Perceptron (MLP): MLP algorithm, Sequential and Batch training, Amount of training data, number of hidden layers, when to stop training. The network output and errors, Requirements of activation function.			
UNIT-III	**Dimensionality Reduction**		**8 hours**
Linear discriminant analysis, Principal Component analysis, Factor analysis, Independent Component analysis, locally linear embedding, ISOMAP Models: Gaussian Matrix Models, Nearest Neighbour methods. Support Vector Machine (SVM): Optimal separation, Kernels, SVM algorithm, Extensions of SVM.			
UNIT-IV	**Optimization and Search**		**8 hours**
Gradient Descent, Batch GD, Mini-batch GD, SGD, Going Downhill, least square optimization, conjugate gradients, Exhaustive search, Greedy search, hill climbing. Evolutionary Learning: The genetic algorithm, Genetic operators, punctuated equilibrium, The Knapsack Problems.			
UNIT-V	**Reinforcement Learning**		**8 hours**
State and action spaces, the reward function, Markov chain decision process, Uses of Reinforcement Learning. Learning with tree: Decision Tree, Classification and regression tree, Random Forest. Unsupervised Learning: The k-means algorithm, Vector quantization, The self-organization feature map, Simulated annealing.			
Course Outcomes: At the end of this course students will demonstrate the ability to			
CO 1	Describe the basic concepts of machine learning, statistics, and probability theory.		K1
CO 2	Define and describe the Neurons, neural networks, and multilayer perceptron.		K3
CO 3	Identify the dimensionality of data and reduces it using various mathematical concepts as well as describe the probabilistic learning.		K4
CO 4	Describe and apply various search and optimization techniques to the raw data.		K5
CO 5	Illustrate and apply various learning techniques.		K2

Text books:	
1. Stephen Marsland, “Machine Learing- An Algorithm Perspective”, CRC Press, 2nd edition.	
2. EthemAlpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.	
3. SimanHaykin, “Neural Netowrks”, Prentice Hall of India	
4. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley	
Reference Books	
1. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill	
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India.	
3. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.	
4. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.	
NPTEL/ YouTube/ Faculty Video Link:	
Unit I	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC
Unit II	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC
Unit III	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC
Unit IV	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC
Unit V	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC

Bachelor of Technology Third Year			
Course Code	**BEC0514**	**L T P**	**Credits**
Course Title	**Artificial Intelligence**	**3 0 0**	**3**

Course Objectives: The student will learn about

The various aspect of Artificial Intelligence. They will learn AI towards problem solving inference, perception and knowledge representation. They will be able to demonstrate knowledge about intelligent systems by assembling solutions to concrete computational problems. They will acquire the knowledge of various forms of learning and computation statistics.

Pre-requisites: Basic knowledge of Mathematics, Python, C++, Computational Intelligence

Course Contents / Syllabus

UNIT-I	**Introduction to Artificial Intelligence**	**8 hours**

Historical developments of Artificial Intelligence, well defined learning problems, designing a Learning System. Intelligent Agents: Characteristics of Intelligent Agents, Typical Intelligent Agents, Problem Solving Approach to Typical AI problems.

UNIT-II	**Search Strategies**	**8 hours**

Uninformed Search Strategies: DFS, BFS, Informed Search Strategies: Local search algorithms and optimistic problems, adversarial Search, Search for games, minimax, Alpha - Beta pruning, Heuristic Search techniques, Hill Climbing, Best-first search, Problem reduction, Constraint satisfaction, Means Ends Analysis, Iterative deepening Heuristic Search and A*.

UNIT-III	**Introduction to Logic**	**8 hours**

Propositional Logic Concepts, Semantic Tableaux and Resolution Propositional logic, FOPL, Semantic Tableaux and Resolution in FOPL, Logic Programming in Prolog. Production systems and rules for some AI problems: Water Jug Problem, Missionaries-Cannibals Problem, n-Queen problem, monkey banana problem, Travelling Salesman Problem. Knowledge representation, semantic nets, partitioned nets, parallel implementation of semantic nets. Frames, Common Sense reasoning and thematic role frames.

UNIT-IV	**Expert Systems**	**8 hours**

Architecture of Knowledge-Based System, Rule-based systems, Forward and Backward Chaining, Frame Based systems. Architecture of Expert System, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks

UNIT-V	**Optimization Techniques**	**8 hours**

Planning with state Space Search, Conditional Planning, Continuous planning, Multi-Agent Planning, Forms of learning, inductive learning, Reinforcement Learning, learning decision trees, Neural Net learning, and Genetic learning. Probabilistic Methods, Bayesian Theory, Dempster Shafer Theory, Bayes Network. Evolutionary computation: Swarm Intelligence, ant colony optimization. Case Study: Health Care, E-Commerce, Smart Cities.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Elaborate historical perspective of AI and its foundations.	K1
CO 2	Apply principles of AI toward problem solving and drawing inference thereof.	K4
CO 3	Describe perception, knowledge representation, and different learning techniques.	K3
CO 4	Implement architecture of knowledge-Based System, Rule-based systems, and other expert systems.	K5
CO 5	Apply evolutionary computational algorithms and different search algorithms.	K5

Text books

1. Stuart Russell, Peter Norvig, "Artificial Intelligence–A Modern Approach", Pearson Education. Fourth Edition 2021
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill 3rd Edition 2010.

Reference Books

1. Patrick Henry Winston, "Artificial Intelligence", Pearson Education Inc., Third edition.
2. Python Machine Learning: Learn Pythonina Week and Master It. A Hands-On Introduction to Artificial Intelligence Coding, a Project Based Guide with Practical Exercises (7 Days Crash Course, Book2) 2020.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://nptel.ac.in/courses/106102220
Unit II	https://nptel.ac.in/courses/106102220
Unit III	https://nptel.ac.in/courses/106102220
Unit IV	https://nptel.ac.in/courses/106102220
Unit V	https://nptel.ac.in/courses/106102220

Bachelor of Technology Third Year			
Course Code	**BEC0515**	**L T P**	**Credits**
Course Title	**VLSI Technology**	**3 0 0**	**3**

Course Objectives: The student will learn about

An introduction to the principles and processes of microfabrication, with a focus on semiconductor materials and devices. Students will learn about the key steps in microfabrication, such as photolithography, etching, deposition, and diffusion. They will also learn about the properties of semiconductor materials and how they are used to fabricate electronic devices.

Pre-requisites: Basic knowledge of Semiconductor materials

Course Contents / Syllabus

UNIT-I	**Introduction to VLSI Technology**	**8 hours**

Environment for VLSI Technology: Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques. Impurity incorporation: Solid State diffusion modelling and technology; Ion Implantation modelling, technology and damage annealing; characterization of Impurity profiles.

UNIT-II	**Oxidation Techniques**	**8 hours**

Epitaxy: Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.

UNIT-III	**Lithography**	**8 hours**

Optical Lithography, Electron beam lithography, Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: CVD techniques for deposition of Polysilicon, Silicon Dioxide, Silicon Nitride.

UNIT-IV	**Diffusion**	**8 hours**

Models of diffusion in solids, Fick's 1-Dimensional diffusion equation, Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources. Ion-Implantation: Ion-Implantation Technique, Range Theory, Implantation Equipment.

UNIT-V	**CMOS Fabrication Techniques**	**8 hours**

Metal film deposition, Metallization: Metallization Application, Metallization Choices, Evaporation and sputtering techniques, Physical Vapor Deposition, Vacuum Deposition. Failure mechanisms in metal interconnects; multi-level metallization schemes. CMOS fabrication steps.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Understand the basic principles of microfabrication	K4
CO 2	Design and implement microfabrication processes	K3
CO 3	Characterize semiconductor materials and devices	K4
CO 4	Apply microfabrication techniques to fabricate electronic devices	K3
CO 5	Know the safety issues involved in the fabrication process.	K4

Text books:

1. Jaeger, R. C. (2002). Introduction to microelectronic fabrication (2nd ed.).Upper Saddle River, NJ: Prentice Hall.
2. Sze, S. M., & Kwok, K. N. (2006). Physics of semiconductor devices (3rd ed.).Hoboken, NJ: Wiley

Reference Books:

1. Sze, S. M. (1981). VLSI technology (2nd ed.). New York, NY: McGraw-Hill.
2. Madou, M. J. (2002). Fundamentals of microfabrication (2nd ed.). Boca Raton,FL: CRC Press

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-ec02/
Unit II	https://video.search.yahoo.com/search/video;_ylt=AwrjbCfLAhtoPicCgpRXNyoA;_ylu=Y29sbwNncTEEcG9zAzEEdnRpZAMEc2VjA3BpdnM-?p=VLSI+Technology&fr2=piv-web&type=E210US826G0&fr =mcafee#id=7&vid= 5e694387d3485 7a70efe44 d25f2595c7&action=view
Unit III	https://video.search.yahoo.com/search/video;_ylt=AwrjbCfLAhtoPicCgpRXNyoA;_ylu=Y29sbwNncTEEcG9zAzEEdnRpZAMEc2VjA3BpdnM-?p=VLSI+Technology&fr2=piv-web&type=E210US826G0&fr=mcafee#id=15&vid=5fa3bdf0 373ac3724665542bdfb6fb3d&action=view
Unit IV	https://nptel.ac.in/courses/117101106
Unit V	https://www.youtube.com/watch?v=Mkt02iiCcYY

Bachelor of Technology Third Year			
Course Code	**BEC0551**	**L T P**	**Credits**
Course Title	**Wireless Communication**	**0 0 6**	**3**

Course Objectives: The student will learn about

The evolution of wireless communication technologies from 1G to 5G, emphasizing the terminology, system requirements, and design goals that have driven advancements in cellular networks. It covers LTE and its progression to LTE-Advanced, as well as alternative technologies like WiMAX. Students will gain a solid foundation in radio wave propagation, wireless channel modeling, and fading phenomena, including MIMO systems and various statistical models. The course explores multiple access schemes such as FDMA, TDMA, CDMA, and OFDM, and addresses challenges in wireless and ad-hoc networks including security, energy efficiency, and cross-layer design. Emerging technologies such as small cells, cognitive radio, smart antennas, and software-defined radio are examined for their roles in enhancing spectrum efficiency and network capacity. Furthermore, the course delves into WLAN standards (IEEE 802.11 family), and other wireless technologies, providing insight into the design, implementation, and future direction of next-generation wireless communication systems.

Pre-requisites: Analog and Digital Communication

Course Contents / Syllabus

UNIT-I	**Introduction to Wireless Communication**	**8 hours**

Introduction to 1G/2G/3G/4G/5G Terminology. Evolution of cellular systems requirements, goals, and vision of the next-generation wireless communication systems, Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTEA. WiMAX.

UNIT-II	**Introduction to Radio Wave Propagation**	**8 hours**

Introduction to Radio Wave Propagation, Free Space Propagation Model, wireless channel models- path loss and shadowing models; statistical fading models; narrowband and wideband fading models; MIMO channels, Narrowband fading, Wideband fading models, Delay spread and Coherence bandwidth, Doppler spread and Coherence time, Flat fading versus frequency selective fading, Slow fading versus fast fading, Discrete-time model. AWGN.

UNIT-III	**Access Schemes**	**8 hours**

Contention-free multiple access schemes (FDMA TDMA, CDMA, SDMA, and Hybrid), contention- based multiple access schemes (ALOHA and CSMA), Waveforms, Variable subcarrier spacing, supported transmission numerologies. Design Challenges in Ad-hoc wireless networks, the concept of cross-layer design, security in wireless networks, energy-constrained networks, MANET and WSN.

UNIT-IV	**Introduction to OFDM**	**8 hours**

Small cells: Past, present, and future trends of cellular networks coverage and capacity of small cellnetworks, Data transmission using multicarrier modulation for frequency-selective fading channels. Overlapping sub channels, Mitigation of Subcarrier Fading, Discrete Implementation of multicarrier – OFDM. Cyclic prefix, Peak-to average-power-ratio. Multicarrier modulation, OFDM, diversity multiplexing trade-off, OFDM system, smart-antenna: beam forming, cognitive radio, software-defined radio, communication relays, spectrum sharing.

UNIT-V	**Introduction to LTE**	**8 hours**

Introduction to LTE, LTE-A Standards and Technology, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements.

Course Outcomes: At the end of this course students will demonstrate the ability to		
CO 1	Understand the network performance.	K2
CO 2	Understand 5G Handover procedure.	K2
CO 3	Analyze the relation between beamforming, gain and antenna count.	K4
CO 4	Understand and analyze different Physical layer parameters.	K4
CO 5	Investigate path losses.	K3

Text Books:

1. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimeter Wave Wireless Communication., Pearson Education, 2015.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Reference Books:

1. Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)

Links: NPTEL/You Tube/Web Link

Unit I	https://www.youtube.com/watch?v=d7zeaz-NjmM
Unit II	https://www.youtube.com/watch?v=9ujT1upyWVg
Unit III	https://www.youtube.com/watch?v=AKXFwwcww_E
Unit IV	https://www.youtube.com/watch?v=ew0lx9buuXc
Unit V	https://www.youtube.com/watch?v=pnunzdvezto

List of Practical:

S.No	**Name of Experiment**	**CO Mapping**
1	Understand Measures of Network Performance: Throughput and Delay.	CO1
2	Simulate and study 5G Handover procedure.	CO1
3	Simulate and analyze the relation between beamforming gain and antenna count.	CO4
4	Investigate how throughput varies with antenna count.	CO5
5	Investigate how a packet is transmitted over OFDM physical layer.	CO4
6	Analytically estimate (per 3GPP standards) the application throughput for asimple use-case.	CO2
7	Simulate and analyze throughput as different PHY parameters are varied.	CO2
8	Analytically estimate (per 3GPP standards) the application throughput for a simple use-case.	CO3

9	Simulate path loss variation with the distance between the UE and the gNB.	CO4
10	Investigate path loss variation with gNB height. What is the optimal height of a gNB?	CO5
11	To calculate no of channel in FDMA.	CO3
12	To calculate allocated bandwidth for given specification.	CO3
13	To calculate efficiency in TDMA system.	CO3
14	To calculate channel capacity of SISO.	CO4
15	To calculate channel capacity of single input multiple output.	CO4
16	To calculate channel capacity of SIMO with N=40.	CO4
17	To calculate channel capacity of multiple input and single output(MISO) system.	CO4
18	To calculate the channel capacity of MISO of receiver.	CO4
19	To calculate channel capacity of MIMO system.	CO4
20	To calculate the channel capacity of MIMO with different no of receiver and transmitter.	CO4
21	To calculate the channel capacity of SISO system if bandwidth of channel is 1MHZ and SNR is 24db.	CO4
22	To calculate no of channel in FDMA system.	CO3
23	To calculate Allocated BW "Bt" given N, Bc and Bg for a wireless system.	CO2
24	To calculate time in transmitting 1bit of data.	CO2
25	To calculate rate of transmission of data if no of bit and time is given.	CO2
26	To compute total frame efficiency in TDMA system.	CO3
27	To compute the total no of overhead bits(Nov) of TDMA system if eff is given.	CO3
28	To calculate vulnerable time for pure aloha.	CO3
29	To calculate the vulnerable time for slotted aloha.	CO3
30	To calculate the throughput in KBPS for pure aloha.	CO3
31	To calculate no of station given other parameters of pure aloha.	CO3
32	To calculate the no of frame per second by each station.	CO3
33	To calculate the coherent time in Doppler shift.	CO2
34	To calculate the no of channel in pure aloha.	CO3
35	To calculate the maximum throughput of pure aloha given BW.	CO3
36	To calculate the throughput of each station of if probability of each is given.	CO3

37	To find AMPS communication level.	CO1
38	To find comparison of capacity.	CO1
39	To find Capacity of GSM.	CO5
40	To find frame duration.	CO5

Bachelor of Technology Third Year			
Course Code	**BEC0552**	**L T P**	**Credits**
Course Title	**Computer Networks**	**0 0 6**	**3**

Course Objectives: The student will learn about

Computer networking, different components of computer networks, various protocols, modern technologies, future networking and their applications. Also, by applying these knowledge students can design, develop and analysed various types of networks.

Pre-requisites: Basic knowledge of Digital system design and Computer System.

Course Contents / Syllabus

UNIT-I	**Introduction to Network Model**	**8 hours**

Network Model: OSI Model, TCP/IP reference model, Network devices, Mode of communications

Physical Layer: Network topology design, Types of LAN, wired networking media (LAN cables, and OFC), transmission impairments, Switching techniques, IEEE standards.

Data Link layer: Framing, Error Detection and Correction codes, Flow control protocols, Channel allocation, Multiple access protocols.

UNIT-II	**Network and Transport Layer**	**8 hours**

Network Layer: Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), IPv4, Subnetting, Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms.

Transport Layer: Process-to-process delivery, Transport layer protocols (UDP and TCP), Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.

UNIT-III	**Virtual Private Network**	**8 hours**

Application Layer: Web and HTTP, E-mail, DNS, Socket programming with TCP and UDP. DNS, electronic mail, World Wide Web: architectural overview, dynamic web document and http.

Virtual Private Network: VPN--Introduction to VPNs, VPN protocols and encryption algorithms, OpenVPN installation and configuration, Secure communication using Open VPN.

UNIT-IV	**Modern Networking**	**8 hours**

Next Generation IP : IPv4 vs. IPv6, Representation, address space, IPv6 header format, IPv6 extension, IPv6 routing architecture, Auto configuration, renumbering, Transition from IPv4 to IPv6- Dual stack, Tunneling, Header, Translation IPv6, Protocol- Packet format, Extension header, QOS.

Modern Networking: Network Virtualization, SDN, Comparison between SDN and traditional networks, SDN controller, Switch design, Switch Protocols, Open Flow Protocol, Network Function Virtualization, Architecture, NFV for 5G, Distributed Network Architecture.

UNIT-V	**Future Network**	**8 hours**

Softwarized and Programmable Network - Programmable Networks - Introduction to Protocol Independent Packet Processors, P4 programming, Serverless computing, Smart NICS and P4 switches. Introduction to Data Center Networking.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Use the UTP cable with RJ-45 connector to build and test simple networks.	K5
CO 2	Implement the protocols of the data link layer and network layer using codes.	K3

CO 3	Design and evaluate the various network connections using modern tool.	K4
CO 4	Demonstration and implementation of the VLAN and.	K3
CO 5	Examine the P4 language for various purposes.	K5

Text Books:

1. Behrouz Forouzan, "Data Communication and Networking" Fourth Edition-2006, Tata McGraw Hill.
2. Andrew Tanenbaum "Computer Networks", Fifth Edition-2011, Prentice Hall.
3. William Stallings, "Data and Computer Communication", Eighth Edition-2008, Pearson.

Reference Books:

1. Kurose and Ross, "Computer Networking- A Top-Down Approach", Eighth Edition-2021, Pearson.
2. Peterson and Davie, "Computer Networks: A Systems Approach", Fourth Edition-1996, Morgan Kaufmann
3. Software-Defined Networks: A Systems Approach, Peterson, Cascone, O'Connor, Vachuska, and Davie, Online Free Reference Book available at https://sdn.systemsapproach.org/index.html
4. Cloud Networking: Understanding Cloud-based Data Centre Networks, Gary Lee (Author), Morgan Kaufmann (Publisher), 2014,ISBN-139780128007280

Links: NPTEL/You Tube/Web Link

Unit I	https://www.youtube.com/watch?v=LX_b2M3IzN8, https://www.youtube.com/watch?v=LnbvhoxHn8M
Unit II	https://www.youtube.com/watch?v=uwoD5YsGACg, https://www.youtube.com/watch?v=ddM9AcreVqY
Unit III	https://www.youtube.com/watch?v=qZlMS4yJM-E
Unit IV	https://www.youtube.com/watch?v=FkaFr3cpg6U, https://www.youtube.com/watch?v=CaukSKg_sI0
Unit V	https://www.youtube.com/watch?v=CWQUI7zw9ac , https://www.youtube.com/watch?v=6kPqzgPiz8w

List of Practical:

S.No	Name of Experiment	CO Mapping
1	Study of cables, tools, connectors etc used in networking.	CO1
2	Study of Network Devices.	CO1
3	Test the Network connection using ping, ipconfig etc command.	CO1
4	Implementation of netstat, trcert etc command for network connection.	CO1
5	Build and test simple network using UTP cable (crossover and straight), network devices and a hub based topology.	CO1
6	Build and test simple network using UTP cable (crossover and straight), network devices and a bus topology.	CO1

7	Build and test simple network using UTP cable (crossover and straight), network devices and a ring topology.	CO1
8	Build and test simple network using UTP cable (crossover and straight), network devices and a mesh topology.	CO1
9	Build and test simple network using UTP cable (crossover and straight), network devices and a hybrid topology.	CO1
10	Build and test simple network using UTP cable (crossover and straight), network devices and a tree topology.	CO1
11	Implementation of data link layer framing method for bit stuffing in any language like C++, Java or Python.	CO2
12	Implementation of data link layer framing method for byte stuffing in any language like C++, Java or Python.	CO2
13	Implementation of data link layer framing method for character count in any language like C++, Java or Python.	CO2
14	Implementation of data link layer for frame size framing in any language like C++, Java or Python.	CO2
15	Implementation of VRC algorithm in any language like C++ , Java or Python.	CO2
16	Implementation of LRC algorithm in any language like C++ , Java or Python.	CO2
17	Implementation of Checksum algorithm in any language like C++ , Java or Python.	CO2
18	Implementation of CRC algorithm in any language like C++ , Java or Python.	CO2
19	Construction of Hamming code (7, 4) code any language like C++ , Java or Python.	CO2
20	Detection of Hamming code (7, 4) code any language like C++ , Java or Python.	CO2
21	Correction of Hamming code (7, 4) code any language like C++ , Java or Python.	CO2
22	Implementation of simplest protocol in any language like C++ , Java or Python.	CO2
23	Implementation of stop and wait protocol in any language like C++ , Java or Python.	CO2
24	Implementation of stop and wait ARQ protocol in any language like C++ , Java or Python.	CO2
25	Implementation of sliding window protocol in any language like C++ , Java or Python.	CO2
26	Implementation of Go –Back –N- ARQ protocol in any language like C++ , Java or Python.	CO2
27	Implementation of Selective Repeat ARQ protocol in any language like C++ , Java or Python.	CO2
28	Implementation of Caesar cipher technique & RSA algorithm in any language like C++ , Java or Python.	CO2
29	Write a program in java to find the IP address of the system.	CO2
30	Write a program in java to find the IP address of the any site if name is given.	CO2
31	Write a C/C++ program to determine if the IP address is in Class A, B, or C.	CO2
33	Write a C/C++ program to translate dotted decimal IP address into 32 bit address.	CO2
34	Write a C/C++ program to determine if the IP address is in Class A, B, C, D, or E.	CO2
35	Implement Dijkstra‘s algorithm to compute the Shortest path through a graph.	CO3

36	Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm.	CO3
37	. Take an example subnet of hosts. Obtain broadcast tree for it.	CO3
38	Create a socket for HTTP for web page upload and download	CO3
39	Study and implement model for Socket Programming and Client – Server model.	CO3
40	Experimental study of application protocols such as HTTP, FTP,SMTP, using network packet sniffers and analyzers such as Wireshark. Small exercises in socket programming in C/C++/Java..	CO3
41	Set up IPv6 networks and configure devices to communicate using IPv6 addresses.	CO3
42	set up a network with multiple devices, assign QoS policies to different traffic flows (e.g., voice, video, data), and measure the impact of QoS on performance metrics such as latency, packet loss, and throughput.	CO3
43	Introduction to CISCO Packet Tracer.	CO3
44	Performing an Initial Switch Configuration	CO3
45	Performing an Initial Router Configuration	CO3
46	Connect the computers in Local Area Network.	CO3
47	Configuring and Troubleshooting a Switched Network	CO3
48	Design a Bus Topology and check the connectivity using ping command.	CO3
49	Design a Star Topology and check the connectivity using ping command.	CO3
50	Design a Mesh Topology and check the connectivity using ping command.	CO3
51	Design a Ring Topology and check the connectivity using ping command.	CO3
52	Design a Hybrid Topology and check the connectivity using ping command.	CO3
53	Configuring and Troubleshooting a Switched Network on simulator.	CO3
54	Configuring Wired Equivalent Privacy (WEP) on a Wireless Router on simulator.	CO3
55	Examining WAN Connections on simulator.	CO3
56	Examining Network Address Translation (NAT) on simulator.	CO3
57	Configuring a Cisco Router as a DHCP Server.	CO3
58	Demonstration of Connection management using Network Simulator.	CO3
59	Demonstration of Flow control and retransmission using Network Simulator.	CO3
60	Demonstration of Window management using Network Simulator.	CO3
61	Demonstration of TCP Congestion control using Network Simulator.	CO3
62	Demonstration of Application layer protocols using Network Simulator.	CO3

63	Setting up a Virtualized Network Environment using VMware.	CO4
64	Introduction to openflow controller	CO4
65	Perform the network segmentation using VLANS	CO4
66	Introduction to SDN controllers.	CO4
67	Traffic engineering with SDN	CO4
68	Network monitoring and Traffic analysis.	CO4
69	Network Function Virtualization with SDN	CO4
70	Familiarize students with the P4 language syntax and concepts.	CO5
71	Design and implement a simple P4 program to process packets at the data plane.	CO5
72	Define match-action tables, packet parsing, and forwarding rules.	CO5
73	Implement a P4 program to classify network traffic based on different criteria (e.g., source/destination IP, port numbers).	CO5
74	Implement packet sampling techniques for capturing statistics and monitoring network performance.	CO5
75	Develop a mini project based on programming/ simulator skills.	

Bachelor of Technology Third Year			
Course Code	**BEC0511P**	**L T P**	**Credits**
Course Title	**Embedded System Design Lab**	**0 0 4**	**2**

Course Objectives: The student will learn about		**Bloom's Level**
1	Writing different programs for Arm based microcontroller.	K3
2	Freedom KL25Z board to build a system.	K5
3	Arm-based embedded system, and program to satisfy given user specifications.	K5
4	Commercial tools to develop Arm-based embedded systems.	K2
5	Commercial API and tools to accelerate the development cycle of Arm-based embedded systems.	K4

Pre-requisites: Basics of Microprocessor and Microcontroller

List of Experiments

S.No	**Name of Experiment**	**CO**
1	Describe architecture and Pin diagram of Freedom KL25Z board.	CO2
2	Write and compile the code to perform the arithmetic operations in ARM thumb instruction set.	CO1
3	Write and compile the code to perform logical operations in ARM thumb instruction set.	CO3
4	Write and compile code to perform Shift operations in ARM instruction set.	CO3
5	Write an assembly code subroutine to approximate the square root of an argument using the bisection method.	CO3
6	Write the Thumb code to multiply the two 32-bit in memory at addresses 0x1234_5678 and 0x7894_5612, storing the result in address 0x2000_0010.	CO2
7	Write and compile assembly code and debug the program image on a mbed board (namely the Freedom KL25Z board) using the Keil MDK-ARM tool.	CO4
8	Write a program to configure a General-Purpose Input Output (GPIO) peripheral in a low-level (register-level) in practice.	CO3
9	Write and compile assembly code of I/O interfacing and debug the program image on a KL25Z board using the Keil MDKARM tool. Interface LEDs and Switches.	CO5
10	Write and compile assembly code of Sensor interfacing and debug the program image on an KL25Z board using the Keil MDK-ARM tool. Interface PIR sensor-and DHT sensor.	CO5

Course Outcome: After successful completion of this Lab students will be able to		**Blooms Level**
CO 1	Write a program for Arm based microcontroller.	K1
CO 2	Analyze Freedom KL25Z board to build a system.	K4
CO 3	Build an Arm-based embedded system, and program to satisfy given user specifications.	K3
CO 4	Use commercial tools to develop Arm-based embedded systems.	K3
CO 5	Use commercial API and tools to accelerate the development cycle of Arm-based embedded systems	K3

Bachelor of Technology Third Year			
Course Code	**BEC0512P**	**L T P**	**Credits**
Course Title	**AI & ML Lab**	**0 0 4**	**2**

Course Objectives: The student will learn about		**Bloom Level**
1	Implement the blind search algorithm.	K3
2	Implement the different AI based problem	K3
3	Apply various chaining algorithm in AI using python/Open CV	K4
4	Apply appropriate data sets to the Machine Learning algorithms.	K4
5	Identify and apply Machine Learning algorithms to solve real world problems.	K5

Pre-requisites: Basics of Python

List of Experiments

S.No	**Name of Experiment**	**CO**
1	Implementation of Python basic Libraries such as Math, Numpy and Scipy.	CO1
2	Implementation of Python Libraries for ML application such as Pandas and Matplotlib.	CO1
3	Creation and Loading different datasets in Python.	CO1
4	Familiarizing with Anaconda for importing modules and dependencies for ML.	CO1
5	Familiarizing with Jupyter for importing Modules and dependencies for ML.	CO1
6	Write a python program to compute Mean, Median.	CO1
7	Write a python program to compute Mode, Variance and Standard Deviation using Datasets.	CO1
8	Write a Program to Implement Breadth First Search using Python.	CO1
9	Write a Program to Implement Depth First Search using Python.	CO1
10	Write a program to implement Hill Climbing Algorithm using Python.	CO2
11	Write a program to implement Tic-Tac-Toe Game using Python.	CO2
12	Write a Program to implement Game Playing Algorithms: Minimax.	CO2
13	Write a Program to Implement A* Algorithm using Python.	CO2
14	Write a Program to implement Game Playing Algorithms: Alpha Beta Pruning.	CO2
15	Write a Program to implement Chatbot in Python.	CO2
16	Write a Program to Implement Missionaries Cannibals Problems using Python.	CO2
17	Write a Program to Implement 8-Puzzle Problem using Python.	CO2
18	Write a program to solve water jug problem using Python.	CO2
19	Write a program to solve Monkey banana problem using Python.	CO2
20	Write a program to Implement N-Queens Problem Using Python.	CO2
21	Write a program to Implement of Traveling Salesman using Python.	CO2
22	Write a Program to Implement Tower of Hanoi using Python.	CO2
23	Write a Program to Implement Forward Chaining.	CO3
24	Write a Program to Implement Backward Chaining	CO3

25	Implement the S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .csv file.	CO4
26	For a given set of training data examples stored in a .csv file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	CO4
27	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	CO4
28	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	CO4
29	Implement the S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .csv file.	CO4
30	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .csv file. Compute the accuracy of the classifier, considering few test data sets.	CO5
31	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	CO5
32	Apply EM algorithm to cluster a set of data stored in a .csv file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	CO5
33	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	CO5
34	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO5
Course Outcome: After successful completion of this Lab students will be able to		**Blooms Level**
CO 1	Implement the blind search algorithm.	K3
CO 2	Implement the different AI based problem	K3
CO 3	Apply various chaining algorithm in AI using python/Open CV	K4
CO 4	Apply appropriate data sets to the Machine Learning algorithms.	K4
CO 5	Identify and apply Machine Learning algorithms to solve real world problems.	K5

Bachelor of Technology Third Year			
Course Code	**BNC0501**	**L T P**	**Credits**
Course Title	**Constitution of India**	**2 0 0**	**NC**
Course Objectives: The student will learn about			
1	Learn the legacies of constitutional development in India and understand the most diversified legal document of India and philosophy behind it.		K1, K2
2	Aware of the theoretical and functional aspects of the Indian Parliamentary System.		K1
3	Understand the legal concepts and its implications for engineers.		K2
4	Learn the law of intellectual property rights.		K1
5	Learn the role of engineering in business organizations and e-governance.		K1
Pre-requisites: Political science			
Course Contents / Syllabus			
UNIT-I	**Introduction and Basic Information about Indian Constitution**		**6 hours**
Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre- State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.			
UNIT-II	**Union Executive and State Executive**		**6 hours**
Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, **Powers and Functions of Vice-President**, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.			
UNIT-III	**Introduction and Basic Information about Legal System:**		**4 hours**
law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.			
UNIT-IV	**Intellectual Property Laws and Regulation to Information**		**4 hours**
Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.			
UNIT-V	**Business Organizations and E-Governance:**		**4 hours**

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up.
E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Identify and explore the basic features and modalities about Indian constitution.	K1
CO 2	Differentiate and relate the functioning of Indian parliamentary system at the center and state level.	K2, K3
CO 3	Differentiate different aspects of Indian Legal System and its related bodies.	K2
CO 4	Discover and apply different laws and regulations related to engineering practices.	K3
CO 5	Correlate role of engineers with different organizations and governance models	K4

Text books:

1. M Laxmikanth: Indian Polity for civil services and other State Examination,6th Edition, Mc Graw Hill.
2. Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.
3. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.

Reference Books:

1. BL Wadehra: Patents, Trademarks, Designs and Geological Indication Universal Law Publishing - LexisNexis.
2. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
3. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/eGovernance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

Links:

Unit 1	https://legalaffairs.nalsar.ac.in/students/student/course-details/1
Unit 2	https://www.youtube.com/watch?v=lZ2tvimrLRQ&t=281s
Unit 3	https://www.youtube.com/watch?v=H0_olSSX6D8&t=2s
Unit 4	https://www.youtube.com/watch?v=WvduZOWoft0
Unit 5	https://www.youtube.com/watch?v=7SmrFh88Cuk

Bachelor of Technology Third Year			
Course Code	**BNC0502**	**L T P**	**Credits**
Course Title	**Essence of Indian Traditional Knowledge**	**2 0 0**	**NC**
Course Objectives: The student will learn about			
This course aims to provide basic knowledge about different theories of society, state and polity in India, Indian literature, culture, Indian religion, philosophy, science, management, cultural heritage and different arts in India.			
Pre-requisites: Basic science and Indian Culture			
Course Contents / Syllabus			
UNIT-I	**Society State and Polity in India**		**6 hours**
State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women.			
UNIT-II	**Indian Literature, Culture, Tradition and Practices**		**6 hours**
Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali, Prakrit And Sanskrit, Sikh Literature, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature, Malayalam Literature, Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature			
UNIT-III	**Indian Religion, Philosophy and Practices**		**4 hours**
Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.			
UNIT-IV	**Science, Management and Indian Knowledge System**		**4 hours**
Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India , Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times.			
UNIT-V	**Cultural Heritage and Performing Arts**		**4 hours**
Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Pottery, Painting, Indian Handicraft, UNESCO'S List of World Heritage sites in India, Seals, coins, Puppetry, Dance, Music, Theatre, drama, Martial Arts Traditions, Fairs and Festivals, UNESCO'S List of Intangible Cultural Heritage, Calendars, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema.			
Course Outcomes: At the end of this course students will demonstrate the ability to			
CO 1	Understand the basics of past Indian politics and state polity.		K2
CO 2	Understand the Vedas, Upanishads, languages & literature of Indian society.		K2
CO 3	Know the different religions and religious movements in India.		K4
CO 4	Identify and explore the basic knowledge about the ancient history of Indian agriculture, science & technology, and ayurveda.		K4
CO 5	Identify Indian dances, fairs & festivals, and cinema.		K1

Text books:
1. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
2. S. Baliyan, Indian Art and Culture, Oxford University Press, India
3. Nitin Singhania, Indian Art and Culture: for civil services and other competitive Examinations,3rd Edition,Mc Graw Hill
Reference Books:
1. Romila Thapar, Readings In Early Indian History Oxford University Press, India
2. Basham, A.L., The Wonder that was India (34th impression), New Delhi, Rupa & co.

Bachelor of Technology Third Year			
Course Code	**BEC0601**	**L T P**	**Credits**
Course Title	**5G Technology**	**3 1 0**	**4**
Course Objectives: The student will learn about			
Student will get in-depth understanding of the 5G technology, focusing on its architecture, design principles, and core capabilities. Topics include 5G network components, network slicing, edge computing, and the transition from 4G LTE. Students will explore enabling technologies like massive MIMO, beamforming, and millimeter-wave communication. The course also covers protocols, spectrum management, and latency reduction. Emphasis is placed on real-world applications such as IoT, smart cities, and Industry 4.0, along with 5G security, regulatory aspects, and integration with AI and cloud platforms.			
Pre-requisites: A basic understanding of wireless communication, 4G Technology and networking concepts.			
Course Contents / Syllabus			
UNIT-I	**Introduction to 5G Architecture and Protocols**		**8 hours**
Introduction to 5G RAN (Radio Access Networks), 5G NR Logical architectures, 5G NR Protocol stack (Layer 2 and Layer 3) **Introduction to Physical Layer:** Physical layer techniques, 5G NR MAC layer Architecture, functions, Channel Mapping, Procedures, Headers and Subheaders.			
UNIT-II	**Propagation Scenarios and Channel Modelling**		**8 hours**
Channel modelling requirements, propagation scenarios and challenges in the 5G modelling, Channel Models for mm Wave MIMO Systems. 5G Requirements, Key Capabilities of 5G versus 4G, 5G operating scenario, mm wave technology, Propagation modelling of 5G. The architecture and function of core network nodes in 5G. Components and protocols involved in the 5G core.			
UNIT-III	**Massive MIMO Techniques**		**8 hours**
Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO. Compare legacy (4G LTE) and modern (5G) core architectures. Configuration of 5G CN elements. Beamforming.			
UNIT-IV	**Mobility and Handoff Management**		**8 hours**
Interference and mobility management in 5G, Handoff management in 5G, QoS improvement with 5G, QoS mechanisms offered by 5G, 5G QoS Flow Descriptions and Characteristics. IP Routing: Types of routing protocols, IPv6 addressing.			
UNIT-V	**Network Slicing and Function Virtualization**		**8 hours**
Network Slicing: Concept, architecture, the status of network slicing in 5G standards, network slicing in core networks, network slicing challenges for 5G Networks. Network Functions Virtualization (NFV): Functionality, architecture, advantages for 5G network.			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Demonstrate Radio access network and protocol stack.	K1, K2
CO 2	Analyze indoor and outdoor propagation models.	K1, K2
CO 3	Apply massive MIMO technique in wireless communication.	K2
CO 4	Apply mobility management in heterogeneous and network-controlled handover.	K1, K2
CO 5	Demonstrate the fundamentals of network slicing core networks.	K1, K2, K3

Text books:

1. Martin Sauter "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and MobileBroadband", Wiley-Blackwell, 2017.
2. Afif Osseiran, Jose. F. Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press. Radar Principles, Technology, Applications, Byron Edde, Pearson Education, 2004.
3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos,"New Directions in Wireless Communications Systems From Mobile to 5G", Taylor & Francis, 2018,

Reference Books:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley &Sons.WHHayt and JA Buck, "Engineering Electromagnetic", 7th Edition TMH, 2013.
2. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=aYJncUscfmk
Unit II	https://www.youtube.com/watch?v=khsqASfv2T4&list=PLxJYaXA6j4AbpWZmDztACJNA5vA3rvfM0&index=6
Unit III	https://www.youtube.com/watch?v=am3Zs8QpLLY
Unit IV	https://www.youtube.com/watch?v=q9Pk68iAHVA
Unit V	https://www.youtube.com/watch?v=pUlfcGyFCFo

Bachelor of Technology Third Year			
Course Code	**BEC0611**	**L T P**	**Credits**
Course Title	**Control System and Automation**	**3 0 0**	**3**
Course Objectives: The student will learn about			
The student will learn about the basics of control systems along with analysis of time domain response & concepts of absolute and relative stability for continuous data systems. Also, the concept of state space analysis in a control system & introduction to robotics automation.			
Pre-requisites: Basic knowledge of differential equations, signals and systems, linear algebra, and fundamental electrical engineering concepts.			
Course Contents / Syllabus			
UNIT-I	**Basic of a Control System**		**8 hours**
Transfer function, Basic of a control system, Introduction: open-loop control system, close-loop control system, Block diagram, Signal flow graph, Modelling a control system: Electrical network, Mechanical system, Servo motor.Transient and steady state response, Input test signal, Time response of a first order control system, Time response of a second order control system, steady state Error, Design of controller.			
UNIT-II	**Concept of Stability**		**8 hours**
Stability in terms of characteristic equation, Routh Hurwitz criterion, Root-Locus Technique, Frequency domain analysis of control system, Nyquist stability criterion, stability analysis with the Bode plot, relative stability, Compensation of control system.			
UNIT-III	**State Space Representation**		**8 hours**
State space representation, the concept of state, Block diagram for a state equation, Transfer function decomposition, Solution of state equation, Transfer matrix, Controllability, and Observability. Transfer function of discrete data system, State equations of linear discrete data system, Stability of discrete data system, Steady state error analysis of discrete data control system.			
UNIT-IV	**Introduction to Robot**		**8 hours**
Introduction to Robot: Classification of Robots, Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages. Introduction to RPA.			
UNIT-V	**Introduction to Automation**		**8 hours**
Introduction to Automation: Definition and fundamentals of automation, reasons for Automating, Electro pneumatics: Electro pneumatics, Design of Electro-Pneumatic Circuits, PLC- Architecture, PLC Programming Languages, ladder digs, Ladder Logic, Programming for different types of logic: Timers, Counter. Practical Examples of Ladder Programming.			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Describe the basics of control system with time domain specifications.	K2
CO 2	Explain the concepts of absolute and relative stability for continuous data systems and designing of compensator.	K4
CO 3	Analyse the control system design in state space & describe the discrete data control system.	K4
CO 4	Explain the role control system in robotic	K2
CO 5	Analysis of electro pneumatics hydraulics & discrete control using PLC.	K3

Text books:

1. B.C. Kuo & Farid GolNaraghi, "Automatic Control Systems", 9th Edition, John Wiley India,2008.
2. Saeed B. Niku, " Introduction to Robotics – Analysis, Systems and Application" : PHI 2006.

Reference Books:

1. "Automation, Production Systems and Computer Integrated Manufacturing"- M.P. Grover, Pearson Education.
2. An Introduction to Automated Process Planning Systems" – Tiess Chiu Chang & Richard A. Wysk.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://onlinecourses.nptel.ac.in/noc20_ee90/preview
Unit II	https://onlinecourses.nptel.ac.in/noc21_me49/preview
Unit III	https://www.youtube.com/watch?v=P_PP76flZfw&list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&index=2
Unit IV	https://youtu.be/pSEjWxqE3R0
Unit V	https://onlinecourses.nptel.ac.in/noc20_ee90/preview

Bachelor of Technology Third Year			
Course Code	**BEC0614**	**L T P**	**Credits**
Course Title	**Robotics Design Mechanism**	**3 0 0**	**3**
Course Objectives: The student will learn about			
1	Industrial robots and their operational workspace characteristics & the tools taking part in the manufacturing process.		K2
2	Dynamic analysis of drives.		K4
3	The feedback sensors its types & transporting devices.		K2
4	The feeding materials used according to application & orientation.		K3
5	Functional systems & prototypes of robots.		K2, K3
Pre-requisites: Basics of mathematics and python programming			
Course Contents / Syllabus			
UNIT-I	**Review and Definitions**		**8 hours**
Robots & its Kinds, Definition of Levels, Manipulators, Structure of Automatic Industrial Systems, Non-industrial Representatives of the Robot Family, Relationship between the Level of Robot "Intelligence" and the Product. **Concepts and Layouts:** Processing Layout, Concept of an Automatic Manufacturing Process, Productivity of a Manufacturing Process, Then Kinematic Layout, Rapid Prototyping.			
UNIT-II	**Kinematics and Control of Automatic Machines**		**8 hours**
Electromagnetic Drive, Electric Drives, Hydraulic Drive, Pneumo-drive, Brakes, Drive with a Variable Moment of Inertia. **Kinematics and Control of Automatic Machines:** Position Function, Camshafts, Master Controller, Amplifiers, Dynamic Accuracy, Damping of Harmful Vibrations, Automatic Vibration Damping, Electrically Controlled Vibration Dampers.			
UNIT-III	**Transporting Devices**		**8 hours**
Linear and Angular Displacement Sensors, Speed and Flow-Rate Sensors, Force Sensors Temperature Sensors, Item Presence Sensors. **Transporting Devices**: General Considerations, Linear Transportation, Rotational Transportation, Vibrational Transportation			
UNIT-IV	**Types of Orientation**		**8 hours**
Introduction, Feeding of Liquid and Granular Materials, Feeding of Strips, Rods, Wires, Ribbons, Feeding of Oriented Parts from Magazines, Feeding of Parts from Bins, General Discussion of Orientation of Parts, Passive Orientation, Active Orientation, Logical Orientation, Orientation by Non-mechanical Means.			
UNIT-V	**Manipulators**		**8 hours**
General Concepts, Automatic Assembling, Special Means of Assembly, Inspection Systems, Miscellaneous Mechanisms. **Manipulators:** Dynamics of Manipulators, Grippers & Guides.			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Explain industrial robots and their operational workspace characteristics & Manipulators.	K1, K2
CO 2	Analyze drives & its control.	K2
CO 3	Describe the use of sensors & solve kinematics of robot manipulators.	K3
CO 4	Apply feed material & orientation.	K4, K5
CO 5	Create application-based prototypes of robots.	K1, K3

Text books:

1. Ben-Zion Sandler: Robotics designing the mechanisms for automated machinery, Prentice-Hall.
2. Pessen, D. W.: Industrial Automation, John Wiley & Sons, New York.

Reference Books:

1. Schey, John A., Introduction to Manufacturing Processes: Second Edition, McGraw-Hill International.
2. Critchlow, Arthur J., Introduction to Robotics, Macmillan Publishing Company, New York,Collier Macmillan Publishers, Londo

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://onlinecourses.nptel.ac.in/noc20_ee90/preview
Unit II	https://onlinecourses.nptel.ac.in/noc21_me49/preview
Unit III	https://www.youtube.com/watch?v=P_PP76flZfw&list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&index=2
Unit IV	https://youtu.be/pSEjWxqE3R0
Unit V	https://onlinecourses.nptel.ac.in/noc20_ee90/preview

Bachelor of Technology Third Year			
Course Code	**BEC0612**	**L T P**	**Credits**
Course Title	**Image Processing and Pattern Recognition**	**3 0 0**	**3**
Course Objectives: The student will learn about			
1	Basics of digital image and various operations on it.		K1, K2
2	Image enhancement techniques in different domains.		K1, K2
3	The various noises in images and restoration methods.		K1, K2
4	Skills to segment a digital image with different methods.		K1, K2
5	The basics of colour image processing and various image compression techniques.		K1, K2
Pre-requisites: Basic fundamental of mathematics and signal processing			
Course Contents / Syllabus			
UNIT-I	**Introduction to Digital Image Processing**		**8 hours**
Digital Image Processing: Definition, Basic image file formats, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels, Applications of DIP.			
UNIT-II	**Image Enhancement Techniques**		**8 hours**
Spatial Domain: Basic Gray Level Transformations, Histogram based Processing, Enhancement using Arithmetic/Logic Operations, Spatial Filtering: Smoothing and Sharpening Filter. **Frequency Domain:** Image Smoothing and Image Sharpening Using Frequency Domain Filters, Homomorphic Filtering.			
UNIT-III	**Image Restoration Model**		**8 hours**
Image Degradation/Restoration process model, Noise Models, Restoration in the presence of noise only spatial filtering, Periodic noise reduction by frequency domain filtering. Compression: Lossless compression: Variable length coding, LZW coding, Bit plane coding, Predictive coding-DPCM, Lossy Compression: Transform coding, Wavelet coding, Basics of Image compression standards: JPEG, MPEG			
UNIT-IV	**Image Segmentation**		**8 hours**
Point, Line and Edge Detection, Thresholding: Otsu and Adaptive, Region-Based Segmentation, Segmentation: Morphological Watershed, K-means and Fuzzy C-means, Wavelet transform, Discrete wavelet transform, Hough transform.			
UNIT-V	**Color Image Processing**		**8 hours**
Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab; False colour; Pseudo colour; Enhancement; Segmentation, Dilation and Erosion Operators, Top Hat Filters			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Apply knowledge of mathematics for image understanding and analysis.	K1, K3
CO 2	Analyse various image enhancement techniques in different domains.	K3, K4
CO 3	Recognize various noises in images and apply restoration methods.	K3, K4
CO 4	Apply different segmentation techniques on image.	K3
CO 5	Apply knowledge of mathematics for image understanding and analysis.	K1, K3

Text books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010.", Prentice Hall of India.
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

Reference Books:

1. Milan Sonka, Vaclav Hlavav, Roger Boyle, ―Image Processing, Analysis and Machine Vision, 2nd ed., Thomson Learning, 2001.
2. Rangaraj M. Rangayyan, ―Biomedical Image Analysis‖, CRC Press, 2005
3. Pratt W.K, ―Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007
4. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://youtu.be/T0bgf3V7u-E
Unit II	https://youtu.be/bJjgyTQ-BT4 https://youtu.be/M7JxDHUW5cc https://youtu.be/JfrcMYBouJE
Unit III	https://youtu.be/MrNafUqh860 https://youtu.be/gLTlQPYY_pw
Unit IV	https://youtu.be/j3_Ck5oP5oI https://youtu.be/q1J0VAYFkHg
Unit V	https://youtu.be/kSzramCsHA4 https://youtu.be/nlwH07G9Efg

Bachelor of Technology Third Year			
Course Code	**BEC0615**	**L T P**	**Credits**
Course Title	**ANN & Deep Learning**	**3 0 0**	**3**
Course Objectives: The student will learn about			
Student will learn about the basic principles and techniques of artificial neural network and deep learning, PCA, auto encoders, CNN, RNN, GRU & LSTM and will also learn how to critically evaluate model performance and interpret results.			
Pre-requisites: Working knowledge of Linear Algebra, Probability Theory. It would be beneficial if the participants have done a course on Machine Learning.			
Course Contents / Syllabus			
UNIT-I	**Introduction to Deep Learning**		**8 hours**
Introduction: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, ANN and its types, Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, RELU activation, Gradient Descent, Activation Functions, Loss Functions, Feed Forward Neural Networks, Back propagation.			
UNIT-II	**Principal Component Analysis**		**8 hours**
Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA, Regularization in auto encoders, De-noising auto encoders, Sparse auto encoders.			
UNIT-III	**Regularization**		**8 hours**
Regularization: Bias Variance Trade-off, L1 and L2 regularization, Drop-outs, Early stopping, Dataset augmentation, Greedy Layer-wise Pre-training, Soft-max layer, Weight initialization methods, Batch Normalization, Learning Vectorial Representations of Words.			
UNIT-IV	**Convolutional Neural Networks**		**8 hours**
Convolutional Neural Networks: Convolution, Padding, Stride, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, ResNet, DenseNet.			
UNIT-V	**Recurrent Neural Networks**		**8 hours**
Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models.			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Describe the fundamental concepts, history, and architecture of neural networks and deep learning.	K2
CO 2	Implement and analyze gradient-based optimization algorithms and dimensionality reduction techniques like PCA.	K4
CO 3	Apply regularization methods and optimization strategies to train efficient deep learning models.	K5
CO 4	Compare and contrast popular deep learning architectures such as CNNs (LeNet, AlexNet, VGG, ResNet, etc.).	K4
CO 5	Design and implement RNN, LSTM, and GRU-based models for sequential data analysis.	K3

Text books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep learning, MIT Press, 2016

Reference Books:

1. Nielsen, Michael A. Neural Networks and Deep Learning. Determination Press, 2015.
2. Machine Intelligence: Demystifying Machine Learning, Neural Networks and Deep Learning, Notion Press, 2019.
3. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=OBFZPivcdqg
Unit II	https://www.youtube.com/watch?v=4TC5s_xNKSs
Unit III	https://www.youtube.com/watch?v=xbYgKoG4x2g
Unit IV	https://www.youtube.com/watch?v=aPfkYu_qiF4
Unit V	https://www.youtube.com/watch?v=wPz3MPl5jvY

Bachelor of Technology Third Year			
Course Code	**BEC0613**	**L T P**	**Credits**
Course Title	**VLSI Testing and Reliability**	**3 0 0**	**3**
Course Objectives: The student will learn about			
1	Basics of testing and fault modelling		
2	Testing and testability of combinational circuits		
3	Testing and testability of combinational circuits		
4	Built-in Self-Test (BIST), Memory and delay faults including IDDQ Testing		
5	Verification using UVM		
Pre-requisites: Fundamental knowledge of VLSI circuits			
Course Contents / Syllabus			
UNIT-I	**Introduction to VLSI Testing**		**8 hours**
Introduction, Principle of testing, Types of testing, DC and AC parametric tests, Fault modelling, Stuck-at fault, Fault equivalence, Fault collapsing, Fault dominance, Fault simulation, Temporary Faults, Testing of Chips, Automatic test equipment.			
UNIT-II	**Test Generation Basics**		**8 hours**
Test generation basics, Test generation algorithms, Path sensitization, Boolean difference, D-algorithm, Testable combinational logic circuit design, The Reed Mullar Expansion Technique, Three-Level OR AND-OR Design, Automatic Synthesis of Testing Logic, Testable Design of Multilevel Combinational Circuits, Synthesis of Random Pattern Testable Combinational Circuits, Path Delay Fault Testable Combinational Logic Design, Testable PLA Design.			
UNIT-III	**Testing of Sequential Circuits**		**8 hours**
Testing of sequential circuits as iterative combinational circuits, state table verification, test generation based on circuit structure, Design of testable sequential circuits, Ad Hoc design rules, scan path technique (scan design), Partial scan, Level Sensitive Scan Design, Random Access Scan Technique, Partial Scan, Testable Sequential Circuit Design Using Non scan Techniques, Cross Check, Boundary Scan.			
UNIT-IV	**Test Pattern Generation**		**8 hours**
Test pattern generation of Built-in Self-Test (BIST), Output Response Analysis, Circular BIST, BIST Architectures. Testable memory design, RAM fault models, test algorithms for RAMs, Delay faults, Delay test, IDDQ testing, testing methods, limitations of IDDQ Testing, BIST Techniques for Ram Chips, Test Generation and BIST for Embedded RAMs.			
UNIT-V	**Introduction to Universal Verification Methodology**		**8 hours**
Introduction to Universal Verification Methodology (UVM), Transaction, Test bench & its component, UVM class factory overview, UVM reporting, Device Under Test (DUT) and its connection with environment, Scoreboards, coverage, predictors, monitors, Hierarchy in UVM, Factory Overrides, Interfaces in UVM, Configuration, Introduction of sequences, Multiple Sequences configuration, UVM register Model, RM & its use in verification, RM integration, TLM (Transaction Level Modelling).			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Understand the basics of testing and fault modelling	K1,K2
CO 2	Analyze the testing and testability of combinational circuits	K2
CO 3	Understand and analyze the testing and testability of combinational circuits	K4,K6
CO 4	Understand the Built-in Self-Test (BIST) and Memory and delay faults including IDDQ Testing	K4 ,K5
CO 5	Understand the Verification using UVM	K1,K3

Text books:

1. N. K. Jha and S. G. Gupta, “Testing of Digital Systems”, Cambridge University Press.
2. M. L. Bushnell and V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits”, Kluwar Academic Publishers
3. P. K. Lala, “Digital Circuit Testing and Testability”, Academic Press

Reference Books:

1. Zainalabe Navabi, “Digital System Test and Testable Design: Using HDL Models and Architectures”, Springer..
2. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://www.youtube.com/watch?v=ynKZLc-wtQA
Unit II	https://www.youtube.com/watch?v=MgCFUO2BrkQ
Unit III	https://www.youtube.com/watch?v=X7oB78Rq-0s
Unit IV	https://www.youtube.com/watch?v=t4h1Jb5aQxM
Unit V	https://www.youtube.com/watch?v=xAhbTylDT6k

Bachelor of Technology Third Year			
Course Code	**BEC0616**	**L T P**	**Credits**
Course Title	**Real Time Operating System**	**3 0 0**	**3**
Course Objectives: The student will learn about			
1	Embedded OS internals.		K2
2	The basic concepts of Real Time Operating System.		K2
3	Concepts of Process and Task Scheduling.		K3
4	Strategies to interface memory and I/O with RTOS kernel.		K4
5	Architecture of CMSIS-RTOS & process of RTX task management.		K3
Pre-requisites: Basic fundamental of microprocessor, microcontroller & Embedded System			
Course Contents / Syllabus			
UNIT-I	**Linux Internals**		**8 hours**
Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication – Semaphore, Pipes, FIFO, Shared Memory Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network.			
UNIT-II	**OS Overview**		**8 hours**
OS overview: OS components, OS structure, Types of Operating Systems, Basics of RTOS: Real-time concepts, Characteristics of RTOS, Architecture of RTOS, Classification of RTOS: Hard Real time and Soft Real-time, Firm real time system, Advantage and disadvantage of RTOS.			
UNIT-III	**Process**		**8 hours**
Process: Introduction, Memory lay out of an executing program, Process control block, Process creation, Process Termination, Context Switching and States.			
UNIT-IV	**Concurrency**		**8 hours**
Concurrency: Concurrency Scheduling, Multiprocessing environment, Read-write by multiple CPUs and consistency problem, Solutions with Mutual Exclusion, Hardware Mutex, Software Mutex, Example: Dekker's algorithm, Semaphore, Deadlock, Bankers algorithm. Memory Management: Processes Need Memory, Address Binding & its types, Memory Hierarchy, Virtual Memory, Memory Partitioning, Paging, Segmentation with Paging, File System, File Structure, Directory Structure, Disk, Interrupt & DMA.			
UNIT-V	**Introduction to RTX**		**8 hours**
RTX : RTX structure, RTX files, RTX task and time management, Simple Time Management APIs, Task Priority Scheme in RTX, Inter-Task Communication, Event, Interrupt, Mutex, Semaphore, Mailboxes and Messages in RTX , RTX control functions, Architecture of CMSIS-RTOS.			
Course Outcomes: At the end of this course students will demonstrate the ability to			

CO 1	Explain the basics Embedded OS internals.	K1, K2
CO 2	Realize the basic concepts of RTOS.	K1, K4
CO 3	Apply the concepts of Process and Task Scheduling.	K3
CO 4	Implement strategies to interface memory and I/O with RTOS kernel.	K2
CO 5	Analyze the architecture of CMSIS-RTOS & process of RTX task management.	K2, K4

Text books

1. Jonathan W. Valvano, "Real-Time Operating Systems for ARM Cortex-M Microcontrollers" Jonathan Valvano; 4 edition.
2. Jerry Cooperstein , "Writing Linux Device Drivers: A Guide with Exercises", J. Cooperstein publishers ,2009

Reference Books

1. Qing Li and CarolynYao,"Real Time Concepts for Embedded Systems" – Qing Li, Elsevier ISBN:1578201241 CMP Books © 2000

NPTEL/ YouTube/ Faculty Video Link:

Unit I	https://youtu.be/T0bgf3V7u-E
Unit II	https://youtu.be/bJjgyTQ-BT4 https://youtu.be/M7JxDHUW5cc https://youtu.be/JfrcMYBouJE
Unit III	https://youtu.be/MrNafUqh860 https://youtu.be/gLTlQPYY_pw
Unit IV	https://youtu.be/j3_Ck5oP5oI https://youtu.be/q1J0VAYFkHg
Unit V	https://youtu.be/kSzramCsHA4 https://youtu.be/nlwH07G9Efg

Bachelor of Technology Third Year			
Course Code	**BEC0651**	**L T P**	**Credits**
Course Title	**IoT Architecture and Protocols**	**0 0 6**	**3**

Course Objectives: The student will learn about

1	To understand the components, layers, and architecture of IoT systems including device, network, and application layers.	K2
2	To develop the ability to interface sensors with microcontrollers and transmit sensor data to the cloud using platforms like ThingSpeak and Blynk.	K2
3	To explore various communication protocols and standards in IoT such as UART, Bluetooth, LoRaWAN, NB-IoT, and M2M.	K1
4	To evaluate the differences and capabilities of IoT architectures and middleware platforms including OIC, IoTivity, and WoT.	K2
5	To simulate and design data communication and control in IoT systems using dashboards, cloud integration, and lightweight data formats	K3

Pre-requisites: Basic of IoT devices

Course Contents / Syllabus

UNIT-I	**Reference Architecture**	**8 hours**

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints, Data representation and visualization, Interaction and remote control, Wireless Sensor Network.

UNIT-II	**IoT Architecture**	**8 hours**

IoT Open-source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction. LoRaWAN architecture, Channel access mechanism specific to NB-IoT.

UNIT-III	**IoT Connectivity Protocols**	**8 hours**

IoT Connectivity Overview, Wireless Long Range (WAN) Protocols, LAN Protocols, Serial Protocols, IoT transmission Protocols, Wired LAN Protocols, Features and security in Bluetooth.

UNIT-IV	**IoT Layered Protocols**	**8 hours**

Protocol Standardization for IoT, Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards Protocols IEEE802.15.4, IEEE 802.11, BAC Net Protocol Modbus, KNX, architecture and Protocol stack used in Zig bee, Network layer, APS layer.

UNIT-V	**Web of Things**	**8 hours**

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Understand the layered architecture and functional components of IoT systems and apply them to real-world applications	K2
CO 2	Implement cloud-based data transmission and remote-control using platforms such as ThingSpeak, Blynk, and IoT dashboards.	K3
CO 3	Analyze communication protocols and technologies including LoRa, NB-IoT, Bluetooth, and serial communication for IoT systems.	K4
CO 4	Evaluate and compare open-source IoT architectures (OIC, IoTivity, WoT) based on scalability, interoperability, and middleware capabilities.	K5
CO 5	Design and simulate M2M, WSN, and cloud-integrated systems using ESP32, LoRa modules, and JSON data representation.	K5

Text Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications,2013.
3. Cuno P fister, Getting Started with the Internet of Things, O" Reilly Media, 2011, ISBN: 978-1.

Reference Books:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

Links: NPTEL/You Tube/Web Link

Unit I	https://onlinecourses.nptel.ac.in/noc21_cs20/unit?unit=49&lesson=53
Unit II	https://www.youtube.com/watch?v=FRxRT0DjE7A
Unit III	https://onlinecourses.nptel.ac.in/noc19_cs65/unit?unit=15&lesson=20
Unit IV	https://onlinecourses.nptel.ac.in/noc19_cs65/unit?unit=15&lesson=19
Unit V	https://www.youtube.com/watch?v=R52OCMtFqNA

List of Practical:

S.No	**Name of Experiment**	**CO Mapping**
1	Understand the layers and components of a basic IoT system.	CO1
2	Transmitting Sensor Data to Cloud (Thing Speak). Send live data from a sensor to a cloud server.	CO1
3	Building a Simple IoT Dashboard to understand data visualization in IoT.	CO1

4	Remote Device Control using Blynk App to enable remote control in an IoT system.	CO1
5	Create JSON strings from sensor data to Explore data formats used in IoT communication.	CO1
6	Analyze a real-life IoT application using reference architecture views. Select a use case (e.g., smart parking).	CO1
7	Understand and compare Open Interconnect Consortium (OIC) and other IoT architectures to Explore OIC and one other architecture (e.g., oneM2M, AllJoyn).	CO1
8	Install and configure IoTivity stack for experimentation.	CO2
9	Explore and analyze the LoRaWAN architecture.	CO2
10	Simulation of LoRaWAN Communication Using LoRa Module to Transmit data between two LoRa devices.	CO2
11	Study channel access and scheduling in NB-IoT to Simulate narrowband communication using NS3 or theoretical Modeling.	CO2
12	Understand serial protocol (UART) communication in IoT. Interface ESP32 with PC via UART.	CO3
13	Interface and control IoT devices using Bluetooth.	CO3
14	Simulate communication between machine-to-machine (M2M) and wireless sensor network (WSN) nodes.(Use two ESP32 boards to simulate sensor-to-sensor data transmission over Wi-Fi.)	CO4
15	Understand conceptual and architectural differences between Web of Things and Internet of Things.	CO5

Bachelor of Technology Third Year			
Course Code	**BEC0652**	**L T P**	**Credits**
Course Title	**Digital Signal Processing**	**0 0 6**	**3**

Course Objectives: The student will learn about

1. Basics of MATLAB signal processing toolbox, Scilab , code composer studio and basic signal operation.
2. Analysis of DFT and fast Fourier transform spectrum from numerical data.
3. Examine the concept of digital IIR filter design.
4. Analysis the concept of digital FIR filter design.
5. Analysis of multi-rate signal processing & adaptive signal processing.

Pre-requisites: Basic knowledge of Digital system design and Computer System.

Course Contents / Syllabus

UNIT-I	**Basics of signal Processing, DFT & FFT**	**8 hours**

Basics of signal processing, classification of signal processing, Applications of Digital Signal Processing in the real world. Frequency Analysis of Discrete-Time Systems: Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Properties of the DFT, Relationship of DFT with DTFT & Z- transform. Linear Filtering using Circular Convolution and Linear Convolution. Fast Fourier Transform: Radix-2 DIT-FFT & DIF-FFT algorithm, inverse DFT using FFT algorithm.

UNIT-II	**Design of IIR Digital Filters**	**8 hours**

Introduction to Filters, Classification of filter, Characteristic of digital filters, Filter Design Specifications. Filter Transformation Technique: Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Analog frequency transformation, Design of Digital Butterworth, and Chebyshev Filters, digital frequency transformation.

UNIT-III	**Design of FIR Digital Filter**	**8 hours**

Linear phase FIR filter, frequency response of linear phase FIR filter, FIR filter Design using Fourier series method: Gibb's phenomenon, FIR filter Design using various window methods, Comparison of FIR & IIR digital filter.

Finite Word length effects in digital filters: Coefficient quantization error, Quantization noise – truncation and rounding, Limit cycle oscillations-dead band effects.

UNIT-IV	**Realization of Digital Systems**	**8 hours**

Introduction- basic building blocks to represent a digital system, recursive and non-recursive systems, basic structures of a digital system: Canonical and Non-Canonical structures. IIR Filter Realization: Direct form, Cascade, Parallel form realization, continued fraction expansion, Ladder structures. FIR Filter Realization: Direct form, Cascade, FIR Linear Phase Realization.

UNIT-V	**Advanced digital Signal Processing**	**8 hours**

Introduction, Decimation, Interpolation, Sampling rate conversion: Single and Multistage, applications of MDSP- Sub-band Coding of Speech signals, Quadrature mirror filters, Advantages of MDSP. Adaptive Filter: Introduction & Example of adaptive Filter, The window LMS Algorithm, Recursive Least Square Algorithm. The Forward-Backward Lattice and Gradient Adaptive Lattice Method. Basics of bio-medical signal processing.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Explain the concept of DFT & FFT and linear filtering using circular and linear convolution.	K2

CO 2	Design the digital IIR filters using various transformation techniques.	K4
CO 3	Design and analyse the FIR Filters and the effect of finite word length in digital filter.	K4
CO 4	Realize the digital system through different methods of realization structures and their utilities	K3
CO 5	Explain the concept of multirate and adaptive signal processing.	K2

Text Books:

1. John G Prokias, Dimitris G Manolakis, "Digital signal processing Principles Algorithms & Applications", 4th edition, Pearson education, 2007.
2. Oppenheim & Schafer, "Discrete Time Signal Processing", Pearson education, Prentice Hall, 2nd edition,2003.

Reference Books:

1. Johnny R. Johnson, "Digital Signal Processing", 3rd edition, PHI Learning pvt ltd., 2009 Reference Books.
2. S.Salivahanan, "Digital signal processing", 6th edition, McGraw Hill Education pvt ltd.
3. Tarun K. Rawat, "Digital Signal Processing",1st edition, Oxford University Press, 2015. 3. S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach, McGraw Hill, 4th Edition.

Links: NPTEL/You Tube/Web Link

Unit I	https://youtu.be/Q8wuqYsdnSs
Unit II	https://youtu.be/3QWvi8EC_DI
Unit III	https://youtu.be/Xl5bJgOkCGU
Unit IV	https://youtu.be/Z1N0qeiw9oE
Unit V	https://youtu.be/HVGW85eGPQQ

List of Practical:

S.No	Name of Experiment	CO Mapping
1	Introduction to MATLAB/ Scilab and Code Composer Studio or its equivalent open-source software.	CO1
2	To study matrix multiplication using code composer studio.	CO1
3	Write a MATLAB program to perform the various matrix operations: addition, subtraction, multiplication, and inverse of the given sequences.	CO1
4	To generate the different type of signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine for both continuous and discrete time signal using MATLAB.	CO1
5	Write a MATLAB program to perform amplitude scaling, time-scaling and time shifting on a given signal x(n)= u(2n-3).	CO1
6	To perform various operations on signals such as addition, multiplication, scaling, shifting and folding, computation of energy and average power using MATLAB program.	CO1
7	To write a MATLAB program to compute autocorrelation and cross correlation between signals.	CO1
8	To write a MATLAB program to find the impulse response& step response of the LTI system governed by the transfer function H(s) =1/S 4s+3.	CO1
9	To Write a MATLAB program to draw Pole-Zero map in Z-Plane.	CO1

10	To write a MATLAB program to find the impulse response& step response of the LTI system governed by the transfer function.	CO1
11	To write a MATLAB Program to generate of continuous time signals like unit step & sawtooth signal.	CO1
12	Write a MATLAB program to compute the autocorrelation of the sequence x(n)= {1,4,1,3}.	CO1
13	Write a MATLAB program to plot a continuous time signal x(t)= cos(6πt) and its sampled version x(nTs), given that fs=10 Hz.	CO1
14	Write a MATLAB program to generate and plot a signal x(n)=u(n)-u(n-10). Also compute and plot the even and odd parts of x(n).	CO1
15	Determine the DTFT of $x(n)=(0.5)^n u(n)$. plots its magnitude, phase, real and complex part.	CO2
16	Evaluate the DFT and IDFT of a given sequences x(n) = {0,1,2,3} and draw the magnitude and phase response of the output sequence using MATLAB.	CO2
17	Study of Discrete Fourier Transform (DFT) and its inverse using virtual Lab.	CO2
18	Analysis of DIT-FFT algorithm for a given sequence x(n)= {n+1} for n= 0, 1, 2, 3 and draw the frequency spectrum of given signals.	CO2
19	Evaluate and verify the linear convolution of the given sequences x(n)= {0,1,0,1} & h(n) = {2,3,4} using MATLAB for linear filtering applications.	CO2
20	Evaluate and verify the circular convolution of the given sequences x(n) = {1,1,1,1} & h(n) = {0,1,0,1} using MATLAB for linear filtering applications.	CO2
21	To obtain linear convolution of the given sequences using code composer studio.	CO2
22	To obtain circular convolution of the given sequences using code composer studio.	CO2
23	To obtain DFT and IDFT of the given sequences using code composer studio.	CO2
24	To Implement Fast Fourier transform (FFT) to analyse the frequency spectrum of digital signals. Also evaluate the relative computational efficiency of the fast Fourier transform algorithm by using DMA based I/P and frame-based processing.	CO2
25	Verify Linear convolution of two sequences using FFT.	CO2
26	Verify Circular Convolution of two sequences using FFT.	CO2
27	To verify FFT as sample interpolator.	CO2
28	Design and analysis of a 2nd order analog Low Pass Butterworth IIR filter for a cut off frequency of 4 KHz also draw the pole-zero diagram, magnitude and phase response using FDA tool.	CO3
29	Design and analysis of a digital Low Pass and High Pass FIR filter using various rectangular and hamming windows for M=7.	CO3
30	IIR filter design using bilinear transformation method on scilab.	CO3
31	Filter Design and Analysis of HPF Butterworth Filter using FDA tool.	CO3
33	Filter Design and Analysis of BPF Butterworth Filter using FDA tool.	CO3

34	Filter Design and Analysis of BSF Butterworth Filter using FDA tool.	CO3
35	Study of Infinite Impulse Response (IIR) filter using virtual Lab.	CO3
36	Write a MATLAB program to design an FIR filter to meet the following specifications : pass band edge= 2 KHz, stopband edge= 5 KHz, passband attenuation=2 dB, stopband attenuation= 42 dB and sampling frequency= 20 KHz.	CO4
37	Write a MATLAB program to design am LPF with passband gain of unity, cut off frequency of 100 Hz and working sampling frequency of 5 KHz using rectangular window. Take the length of the impulse responses M=7.	CO4
38	Write a MATLAB program to design a digital low pass Butterworth filter to satisfy the following: As=16 dB, Ap=7dBΩp=0.2π , Ωs= 0.3π. Use the bilinear transformation method. Assume T= 1 sec.	CO4
39	Write a MATLAB program for the zero-input limit cycle operation. Assume the input x(n)=0.375 δ, impulse response of the system $h(n)= (0.375)^{n} u(n)$, (B+1) and rounding is used for quantization.	CO4
40	Write a MATLAB program to find Q|x| by applying truncation in signed magnitude. Representation for a number x=3/8. Assume a (B+1)= 3-bit register (including sign bit).	CO4
41	Design a digital resonator with a peak gain of unity at f=50 Hz and a 3dB bandwidth of 6 Hz, assuming a sampling frequency of 300 Hz. Plot its pole-zero diagram and magnitude response.	CO4
42	Study of FIR filter design using window method: Lowpass and high pass filter using virtual Lab.	CO4
43	Study of FIR filter design using window method: Bandpass and Band stop filter using virtual Lab.	CO4
44	To design FIR filter using various window function. Also explore the several different methods of measuring its characteristics in the time and frequency domains.	CO4
45	Design and analysis of decimation and interpolation of a given sequence x(n) = {1, 2 ,2, 3, 2, 1} for decimation factor D=4 and interpolation factor I=3.	CO5
46	Write a MATLAB program to observe the effect of down sampling in frequency domain.	CO5
47	Write a MATLAB program to observe the effect of up sampling in frequency domain.	CO5
48	To implement Tone Generation.	CO5
49	To implement floating point arithmetic.	CO5
50	To study about DSP Processors and architecture of TMS320C6713 DSP processor.	CO5
51	Generate a noisy signal, design a low-pass filter, apply the filter, and compare the power spectral density before and after filtering.	CO5
52	Design an adaptive filter that can adjust its coefficients to minimize noise or interference in a signal. Implement adaptive filtering algorithms like recursive least squares (RLS) to enhance signals in various applications.	CO5
53	To study and analysis of LMS algorithm for adaptive FIR filters. Also demonstrate Real-time implementations of noise cancellation and system identification.	CO5

Bachelor of Technology Third Year			
Course Code	**BEC0614P**	**L T P**	**Credits**
Course Title	**Robotics Lab**	**0 0 2**	**1**

Course Objectives: The student will learn about	
1	The basic features of KUKA sim pro software.
2	The various programs on KUKA Sim Pro software.
3	Basics of the KUKA KR10 robotics arm.
4	Programming & Simulation of different task on KUKA KR10 robotics arm.

Pre-requisites: Mechanics, kinematics, dynamics, basic electrical circuits

List of Experiments

S.No	**Name of Experiment**	**CO**
1	Study of KUKA sim pro/ABB Robot Studio software and its features.	CO1
2	Create target, Create path, Create workobject move along the path-linear movement in KUKA sim pro/ABB Robot Studio software.	CO 1
3	Write a simulation program for welding task by using KUKA sim pro/ABB Robot Studio software. • Geometrical path generation • Automated circular path creation	CO 2
4	To write a simulation program for pick & place task on using KUKA sim pro/ABB Robot Studio software.	CO 2
5	Study Teach pandent of KUKA /ABB Robotics Arm.	CO2
6	Study Rapid Programming/ KRL programming and Write a program of pick and place using programming.	CO 3
7	Simulation of finger gripper in KUKA sim pro with the help of a “move tower” project	CO 3
8	To study about robotics arm KR 10 and its features.	CO 4
9	To verify the simulation program for task of pick & place on robotic arm KR-10.	CO 4
10	To verify the simulation program for welding task on robotic arm KR-10	CO 4

Course Outcome: After successful completion of this Lab students will be able to		**Blooms Level**
CO 1	Understand the basic features of KUKA sim pro software/Robot Studio ABB Software.	K2
CO 2	Understand and simulate the various programs on KUKA sim pro software/Robot Studio ABB Software.	K1, K5
CO 3	Learn about the KUKA KR10 robotics arm.	K1, K2
CO 4	Simulate various programs on KUKA KR10 robotics arm.	K5

Bachelor of Technology Third Year			
Course Code	**BEC0612P**	**L T P**	**Credits**
Course Title	**Image Processing and Pattern Recognition Lab**	**0 0 2**	**1**

Course Objectives: The student will learn about	
1	Basic skills for image sharpening and image enhancement.
2	Basic concept of image restoration and compression techniques.
3	Basic concept of image segmentation for image analysis.
4	Analyze the spatial/ texture feature of image.
5	The use of various enhancement and segmentation techniques for developing computer vision application.

Pre-requisites: Basics of Python / MATLAB, Sampling, convolution, Fourier transform, frequency domain concepts

List of Experiments

S.No	**Name of Experiment**	**CO**
1	Write a program using MATLAB/Python to display grey scale/colour images.	CO 1
2	Write a program using MATLAB/Python to extract different attributes (i.e., Geometrical and texture) of an Image.	CO 2
3	Write a program using MATLAB/Python for Image Negation.	CO 2
4	Write a program using MATLAB/Python for Power Law Transformation.	CO 2
5	Write a program using MATLAB/Python for Histogram Mapping and Equalization.	CO 2
6	Write a program using MATLAB/Python for Image Smoothening and Sharpening.	CO 1
7	Write a program using MATLAB/Python for Edge Detection using Sobel, Prewitt and Roberts Operators.	CO 1
8	Write a program using MATLAB/Python for Morphological Operations on Binary Images.	CO 3
9	Write a program using MATLAB/Python for Pseudo Coloring.	CO 5
10	Write a program using MATLAB/Python for the segmentation using watershed transform.	CO 3
11	Write a program to eliminate the high frequency components of an image.	CO 5
12	Write a program using MATLAB/Python to extract the image features for image segmentation using DWT Computation.	CO 4

Course Outcome: After successful completion of this Lab students will be able to		**Blooms Level**
CO 1	Implement image sharpening and image enhancement algorithm.	K3, K4
CO 2	Analyze the power of various image restoration and compression techniques.	K2, K3
CO 3	Learn basic skills for image segmentation and image analysis.	K1, K2
CO 4	Analyze the spatial/ texture features of image.	K2, K3, K4
CO 5	Implement and evaluate different enhancement and segmentation techniques for developing computer vision applications.	K3, K4

Bachelor of Technology Third Year			
Course Code	**BEC0616P**	**L T P**	**Credits**
Course Title	**Real Time Operating System Lab**	**0 0 2**	**1**
Course Objectives: The student will learn About			
1	Understand the architecture and principles of RTOS.		
2	Learn task management, scheduling, synchronization, and inter-task communication using an RTOS.		
3	Implement real-time applications using an RTOS like CMSIS-RTOS, Free RTOS, or RTX.		
4	Perform hands-on experimentation on real or simulated embedded hardware (e.g., STM32, ARM Cortex-M).		
Pre-requisites: Microcontroller architecture, GPIO, timers, serial communication protocols			
List of Experiments			
S.No	**Name of Experiment**		**CO**
1	Setup of toolchain (e.g., Keil uVision, STM32CubeIDE), Introduction to CMSIS-RTOS or FreeRTOS. Blinking LED without RTOS vs. with RTOS.		CO1
2	Create multiple tasks with different priorities; demonstrate task switching and preemption.		CO1
3	Use osDelay, vTaskDelay, and timers. Measure task execution time.		CO2
4	Change task priorities dynamically and observe scheduling behavior.		CO2
5	Use binary and counting semaphores for task synchronization		CO3
6	Implement inter-task communication using message queues.		CO3
7	Use mailboxes or event flags for signaling between tasks.		CO4
8	Use software timers for delayed and periodic task execution.		CO4
9	Explore static and dynamic memory allocation APIs in RTOS.		CO4
10	Implement Round Robin, Rate Monotonic (RM), or Earliest Deadline First (EDF) scheduling.		CO4
Course Outcome: After successful completion of this Lab students will be able to			**Blooms Level**
CO 1	Apply the concepts of RTOS architecture and kernel components in real-time embedded systems.		K3
CO 2	Implement task management, scheduling, synchronization, and inter-task communication using RTOS APIs.		K4
CO 3	Develop and test multitasking applications using CMSIS-RTOS, FreeRTOS, or RTX on ARM Cortex-M		K5
CO 4	Analyze the responsiveness of real-time applications through practical experiments on embedded simulators		K4

Bachelor of Technology Third Year			
Course Code	**BNC0601**	**L T P**	**Credits**
Course Title	**Constitution of India**	**2 0 0**	**NC**
Course Objectives: The student will learn about			
1	Learn the legacies of constitutional development in India and understand the most diversified legal document of India and philosophy behind it.		K1, K2
2	Aware of the theoretical and functional aspects of the Indian Parliamentary System.		K1
3	Understand the legal concepts and its implications for engineers.		K2
4	Learn the law of intellectual property rights.		K1
5	Learn the role of engineering in business organizations and e-governance.		K1
Pre-requisites: Political science			
Course Contents / Syllabus			
UNIT-I	**Introduction and Basic Information about Indian Constitution**		**6 hours**
Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre- State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.			
UNIT-II	**Union Executive and State Executive**		**6 hours**
Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, **Powers and Functions of Vice-President**, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.			
UNIT-III	**Introduction and Basic Information about Legal System:**		**4 hours**
law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.			
UNIT-IV	**Intellectual Property Laws and Regulation to Information**		**4 hours**
Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.			
UNIT-V	**Business Organizations and E-Governance:**		**4 hours**

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up.
E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1	Identify and explore the basic features and modalities about Indian constitution.	K1
CO 2	Differentiate and relate the functioning of Indian parliamentary system at the center and state level.	K2, K3
CO 3	Differentiate different aspects of Indian Legal System and its related bodies.	K2
CO 4	Discover and apply different laws and regulations related to engineering practices.	K3
CO 5	Correlate role of engineers with different organizations and governance models	K4

Text books:

4. M Laxmikanth: Indian Polity for civil services and other State Examination,6th Edition, Mc Graw Hill.
5. Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.
6. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.

Reference Books:

4. BL Wadehra: Patents, Trademarks, Designs and Geological Indication Universal Law Publishing - LexisNexis.
5. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
6. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/eGovernance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

Links:

Unit 1	https://legalaffairs.nalsar.ac.in/students/student/course-details/1
Unit 2	https://www.youtube.com/watch?v=lZ2tvimrLRQ&t=281s
Unit 3	https://www.youtube.com/watch?v=H0_olSSX6D8&t=2s
Unit 4	https://www.youtube.com/watch?v=WvduZOWoft0
Unit 5	https://www.youtube.com/watch?v=7SmrFh88Cuk

Bachelor of Technology Third Year			
Course Code	**BNC0602**	**L T P**	**Credits**
Course Title	**Essence of Indian Traditional Knowledge**	**2 0 0**	**NC**
Course Objectives: The student will learn about			
This course aims to provide basic knowledge about different theories of society, state and polity in India, Indian literature, culture, Indian religion, philosophy, science, management, cultural heritage and different arts in India.			
Pre-requisites: Basic science and Indian Culture			
Course Contents / Syllabus			
UNIT-I	**Society State and Polity in India**		**6 hours**
State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women.			
UNIT-II	**Indian Literature, Culture, Tradition and Practices**		**6 hours**
Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali, Prakrit And Sanskrit, Sikh Literature, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature, Malayalam Literature, Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature			
UNIT-III	**Indian Religion, Philosophy and Practices**		**4 hours**
Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.			
UNIT-IV	**Science, Management and Indian Knowledge System**		**4 hours**
Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India , Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times.			
UNIT-V	**Cultural Heritage and Performing Arts**		**4 hours**
Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Pottery, Painting, Indian Handicraft, UNESCO'S List of World Heritage sites in India, Seals, coins, Puppetry, Dance, Music, Theatre, drama, Martial Arts Traditions, Fairs and Festivals, UNESCO'S List of Intangible Cultural Heritage, Calendars, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema.			
Course Outcomes: At the end of this course students will demonstrate the ability to			
CO 1	Understand the basics of past Indian politics and state polity.		K2
CO 2	Understand the Vedas, Upanishads, languages & literature of Indian society.		K2
CO 3	Know the different religions and religious movements in India.		K4
CO 4	Identify and explore the basic knowledge about the ancient history of Indian agriculture, science & technology, and ayurveda.		K4
CO 5	Identify Indian dances, fairs & festivals, and cinema.		K1

Text books:
1. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
2. S. Baliyan, Indian Art and Culture, Oxford University Press, India
3. Nitin Singhania, Indian Art and Culture: for civil services and other competitive Examinations,3rd Edition,Mc Graw Hill
Reference Books:
1. Romila Thapar, Readings In Early Indian History Oxford University Press, India
2. Basham, A.L., The Wonder that was India (34th impression), New Delhi, Rupa & co.