B. E. (EC / TC) Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER – V				
Technological Innovation and Management Entrepreneurship				
Course Code	BEC501	**CIE Marks**		**50**
Number of Lecture Hours/Week	**03**	**SEE Marks**		**50**
Total Number of Lecture Hours	**40 (08 Hours / Module)**	**Exam Hours**		**03**

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CREDITS-03

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Course Learning Objectives: This course will enable students to:
- Understand basic skills of Management
- Understand the need for Entrepreneurs and their skills.
- Identify the Management functions and Social responsibilities.
- Understand economic development, creativity and Innovation.
- Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding.

MODULE-1	RBT Level
Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession **(Selected topics of Chapter 1, Text1).** **Planning:** Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making **(Selected topics from Chapters 4 & 5, Text 1).**	L1,L2
MODULE-2	
Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; **Staffing**-Need and Importance, Recruitment and Selection Process **(Selected topics from Chapters 7, 8 & 11,Text 1).** **Directing and Controlling:** Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process **(Selected topics from Chapters 15 to 18 and 9, Text 1).**	L1,L2
MODULE-3	
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance **(Selected topics from Chapter 3, Text 1).** **Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship **(Selected topics from Chapter 2, Text 2).**	L1,L2
MODULE-4	

Modern Small Business Enterprises: Role of Small Scale Industries, Impact of Globalization and WTO on SSIs, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Ancillary Industry and Tiny Industry (Definition only) (**Selected topics from Chapter1, Text 2**). **Idea Generation and Feasibility Analysis-** Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities.(**Selected topics from Chapter 6(Page No. 111-117) & Chapter 7(Page No. 140-142), Text 2**)	**L1,L2**
MODULE-5	
Business model – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails? (**Selected topics from Chapter 8 (Page No 159-164, Text 2)** **Financing and How to start a Business?** Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise (**Selected topics from Chapter 7(Page No 147-149), Chapter 5 (Page No 93-99) & Chapter 8(Page No. 166-172) Text 2**) **Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.(**Selected topics from Chapters 20, Text 3**).	**L1,L2, L3**

Course Outcomes: After studying this course, students will be able to:

1. Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business
2. Describe the functions of Managers, Entrepreneurs and their social responsibilities
3. Understand the components in developing a business plan, along with the integration of CSR-Corporate Social Responsibility.
4. Describe the importance of small scale industries in economic development and institutional support to start a small scale industry and understand the concepts of Creativity and Innovation and Identification of Business Opportunities.
 5. Awareness about various sources of funding and institutions supporting entrepreneurs

Text Books:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.
3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.
4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2012.

Reference Book:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Digital Signal Processing		Semester	5
Course Code	**BEC502**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3 Hours
Examination nature (SEE)	Theory		

Course objectives:
1. Preparation: To prepare students with fundamental knowledge/ overview in the field of Digital Signal Processing
2. Core Competence: To equip students with a basic foundation of Signal Processing by delivering the basics of Discrete Fourier Transforms, their properties, efficient computations & the design of digital filters.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.
1. Lecture method (L) does not mean only traditional lecture method, but different type of teachingmethods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts of Digital Signal Processing
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes criticalthinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinkingskills such as the ability to evaluate, generalize, and analyze information rather than simply recallit.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helpsimprove the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and havediscussions on the that topic in the succeeding classes.
10. Give Programming Assignments.

MODULE-1

Introduction: Signals, Systems and Signal Processing, Classification of Signals, The Concept of Frequency in Continuous Time and Discrete Time Sinusoidal Signals. [Text1: 1.1, 1.2, 1.3: 1.3.1, 1.3.2]
Discrete Time Signals and Systems: Discrete Time Signals, Discrete Time Systems, Analysis of Discrete Time Linear Time Invariant Systems.
[Text 1: 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.3.3, 2.3.5]

MODULE-2

Z-Transforms: The z-Transform, Properties of the z-Transform (Statements only), The System Function of a Linear Time Invariant system. Text1:3.1, 3.2, 3.3.3.
The Discrete Fourier Transform: Frequency Domain sampling and Reconstruction of Discrete Time Signals, The DFT, The DFT as Linear Transformation. Properties of DFT: Periodicity, Linearity and Symmetry for real valued sequence, Multiplication of two DFTs and Circular Convolution.
[Text1: 7.1.1, 7.1.2, 7.1.3, 7.2: 7.2.1, 7.2.2]

MODULE-3

DFT Properties: Time reversal of a sequence, Circular Time shift of a sequence, Circular frequency shift, Complex conjugate property, Multiplication of two sequences, Perceval's theorem. Linear Filtering Methods based on the DFT. (Text 1: 7.3).
Efficient Computation of the DFT- FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: computation of DFT and IDFT in decimation in time.
[Text1: 8.1: 8.1.1, 8.1.3].

MODULE-4

Design of FIR Filters: Characteristics of practical frequency-selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR (low pass and High pass) filters using windows - Rectangular, Bartlett, Hanning, Hamming and Blackman windows. Structure for FIR Systems: Direct form and Cascade form.
[Text1: 10.1.2, 10.2.1, 10.2.2]

MODULE-5

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth Filter Design (Lowpass and Highpass) using BLT. Realization of IIR Filters in Direct form I and II.
[Text2: 8.1, 8.2, 8.3 (Butterworth filter design), 8.8.1]

PRACTICAL COMPONENT OF IPCC

List of Programs to be implemented & executed using any programming languages like **Moku:Go/ MATLAB/OCTAVE (but not limited to)**

Sl.NO	Experiments
1	Program to generate the following discrete time signals. a) Unit sample sequence, b)Unit step sequence, c) Exponential sequence, d)Sinusoidal sequence, e) Random sequence
2	Program to perform the following operations on signals. a) Signal addition, b) Signal multiplication, c)Scaling, d) Shifting, e)Folding
3	Program to perform convolution of two given sequences (without using built-in function) and display the signals.

4	Consider a causal system $y(n) = 0.9y(n-1)+x(n)$.
	    a) Determine $H(z)$ and sketch its pole zero plot.
	    b) Plot $\lvert H(e^{j\omega})\rvert$ and $\angle H(e^{j\omega})$
	    c) Determine the impulse response $h(n)$.

5	Computation of N point DFT of a given sequence (without using built-in function) and to plot the magnitude and phase spectrum.
6	Using the DFT and IDFT, compute the following for any two given sequences a)Circular convolution b) Linear convolution
7	Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
8	Develop decimation in time radix-2 FFT algorithm without using built-in functions.
9	Design and implementation of digital low pass FIR filter using a window to meet the given specifications
10	Design and implementation of digital high pass FIR filter using a window to meet the given specifications
11	Design and implementation of digital IIR Butterworth low pass filter to meet the given specifications.
12	Design and implementation of digital IIR Butterworth high pass filter to meet the given specifications

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:
- Analyse the different types of signals and systems used in digital signal processing.
- Compute the response of an LTI system using time and frequency domain techniques.
- Develop algorithms for the efficient computations of DFT and IDFT.
- Design of digital FIR filters for the given specifications using different window methods.
- Design of digital IIR digital filters using bilinear transformation method.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.

- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.

- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**

- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.

- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100)

in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Text Books:

1. Proakis & Manolakis, "Digital Signal Processing - Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.

2. Li Tan, Jean Jiang, "Digital Signal processing - Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893.

3. Vinay K. Ingle, John G Proakis , "Digital Signal Processing Using MATLAB, A problem Solving Companion", Cengage Learning, 2018, ISBN: 93-86668-11-4

Reference Books:

1. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN9971-51- 239-4.

2. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 2017. ISBN:978-1-25-909858

3. Oppenheim & Schaffer, "Discrete Time Signal Processing", PHI, 2003.

4. D Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Web links and Video Lectures (e-Resources):

1. Digital Signal processing, https://nptel.ac.in/courses/117102060

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

DIGITAL COMMUNICATION		Semester	5
Course Code	**BEC503**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
Total Hours of Pedagogy	50 Hours	Total Marks	100
Credits	04	Exam Hours	3 Hours
Examination type (SEE)	**Theory**		

Course objectives:

- Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
- Understand the principles of spread spectrum communications.
- Understand the basic principles of information theory and various source coding techniques.
- Build a comprehensive knowledge about various Source and Channel Coding techniques.
- Discuss the different types of errors and error detection and controlling codes used in the communication channel.
- Understand the concepts of convolution codes and analyze the code words using time domain and transform domain approach.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale communication industries.
3. Show Video/animation films to explain the functioning of various modulation techniques, Channel, and source coding.
4. Encourage collaborative (Group) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Bandpass Signals to Equivalent Lowpass: Hilbert Transform, Pre-envelopes, Complex envelopes of Band-pass Signals, Canonical Representation of Bandpass signals.

Signalling over AWGN Channels- Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel , Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver.

Module-2

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. BFSK using Noncoherent Detection, Differential Phase Shift Keying.

Module-3

Information theory: Introduction, Entropy, Source Coding Theorem, Lossless Data Compression Algorithms, Discrete Memoryless Channels, Mutual Information, Channel capacity, Channel Coding Theorem, Information Capacity Law (Statement).

Module-4

Error Control Coding: Error Control Using Forward error Correction,
Linear Block Codes: Definitions, Matrix Descriptions, Syndrome and its properties, Minimum distance Considerations, Syndrome Decoding, Hamming Codes.
Cyclic Codes: Properties, Generator and Parity Check Polynomial and matrices, Encoding, Syndrome computation, Examples.

Module-5

Convolutional Codes: Convolutional Encoder, Code tree, Trellis Graph and State graph, Recursive systematic Convolutional codes, Optimum decoding of Convolutional codes, Maximum Likelihood Decoding of Convolutional codes: The Viterbi Algorithm, Examples.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :
1. Apply the concept of signal conversion to vectors in communication transmission and receiption.
2. Perform the mathematical analysis of digital communication systems for different modulation techniques.
3. Apply the Source coding and Channel coding principles for the discrete memoryless channels.
4. Compute the codewords for the error correction and detection of a digital data using Linear Block Code, Cyclic Codes and Convolution Codes.
5. Design encoding and decoding circuits for Linear Block Code, Cyclic Codes and Convolution Codes.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB4.2, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Text Book

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, 2014, ISBN 978-81- 265-4231-4.

Reference Books

1. B.P Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems",4th Edition, Oxford University press, ISBN: 9780198073802, 2017
2. K Sam Shanmugam, "Digital and analog communication systems", Wiley India Pvt. Ltd, 2017, ISBN:978-81-265-3680-1,.
3. K.N Hari Bhat, D. Ganesh Rao, "Information Theory and Coding", Cengage Learning India Pvt Ltd, 2017, ISBN: 93-866-5092-4,.

Web links and Video Lectures (e-Resources):
1. Principles of Communication Systems Part II, https://onlinecourses.nptel.ac.in/noc19_ee47/preview
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
1. Experiential Learning by using free and open source software's SCILAB or OCTAVE or Python

Digital Communication Lab		Semester	5
Course Code	BECL504	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Total SEE+CIE	100
		Exam Hours	2 Hours
Examination type (SEE)	Practical		

Course objectives:

This laboratory course enables students to

- Design of basic digital modulation techniques using electronic hardware.
- Simulation of vector computations and derive the orthonormal basis set using Gram Schmidt procedure.
- Simulate the digital transmission and reception in AWGN channel
- Simulate the digital modulations using software and display the signals and its vector representations.
- Implement the source coding algorithms using a suitable software platform.
- Simulate the channel coding techniques and perform decoding for error detection and correction.

Sl.NO	Experiments
	Hardware Experiments
1	Generation and demodulation of the Amplitude Shift Keying signal.
2	Generation and demodulation of the Phase Shift Keying signal.
3	Generation and demodulation of the Frequency Shift Keying signal.
4	Generation of DPSK signal and detection of data using DPSK transmitter and receiver.
Simulation Experiments (Use MUKU:GO / MATLAB / Scilab /LabVIEW or any other suitable software)	
5	Gram-Schmidt Orthogonalization: To find orthogonal basis vectors for the given set of vectors and plot the orthonormal vectors.
6	Simulation of binary baseband signals using a rectangular pulse and estimate the BER for AWGN channel using matched filter receiver.
7	Perform the QPSK Modulation and demodulation. Display the signal and its constellation.
8	Generate 16-QAM Modulation and obtain the QAM constellation.
9	Encoding and Decoding of Huffman code.
10	Encoding and Decoding of binary data using a Hamming code.
11	For a given data, use CRC-CCITT polynomial to obtain the CRC code. Verify for the cases, a) Without error b) With error
12	Encoding and Decoding of Convolution code

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
1. Design the basic digital modulation and demodulation circuits for different engineering applications.
2. Design of optimum communication receivers for AWGN channels.
3. Illustration of different digital modulations using the signals and its equivalent vector representations.
4. Implement the source coding and channel coding procedures using suitable software.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):
CIE marks for the practical course are **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):
- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted by the two examiners. One from the same institute as an internal examiner and another from a different institute as an external examiner, appointed by the university.**
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall

be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:
1. B. P Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems" 4th Edition, Oxford University Press, 2017, ISBJ:978-0-19-947628-2
2. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication Systems", Mc Graw Hill Education, 2013, ISBN: 978-1-25-902985-1.

Intelligent Systems and Machine Learning Algorithms		Semester	5
Course Code	**BEC515A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	THEORY		

Course objectives:

This course will enable students to:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward Problem-Solving
- Get to know approaches of inference, perception, knowledge representation, and learning
- Define Machine Learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised, and reinforcement learning

Teaching-Learning Process (General Instructions)

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These are sample Strategies teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method; different teaching methods may be adopted to develop the outcomes.
2. Encourage collaborative (Group) Learning in the class.
3. Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes criticalthinking.
4. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skillssuch as evaluating, generalizing, and analyzing information rather than simply recalling it.
5. Topics will be introduced in a multiple representation.
6. Show the different ways to solve the same problem and encourage the students to come up withcreative ways to solve them.
7. Discuss how every concept can be applied to the real world and when that's possible, it helps improve the student's understanding.
8. Adopt the Flipped class technique by sharing the materials/Sample Videos before the class and having discussions on the topic in the succeeding classes.

Module-1

Introduction: What is AI? Foundations and History of AI Intelligent Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.

Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4

Module-2

Problem-solving: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search;

Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4

Module-3

Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic

Text book 1: Chapter 3-3.5,3.6 Chapter 4 – 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5

Module-4
Introduction: Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm – Remarks on VS- Inductive bias. Text book 3: Chapter 1, Textbook 4:Chapter 1 and 2
Module-5
End-to-end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model. Classification: MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi-label classification, multi-output classification Textbook 4: Chapter 2, Chapter 3
Course outcome (Course Skill Set)   At the end of the course, the student will be able to: CO1. Apply knowledge of agent architecture, searching, and reasoning techniques for different Applications. CO 2. Compare various Searching and Inferencing Techniques. CO 3. Develop knowledge base sentences using propositional logic and first-order logic CO 4. Understand the concept of Machine Learning and Concept Learning. CO 5. Apply the concept of ML and various classification methods in a project

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:
Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Book:
1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015
2. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition,Tata McGraw Hill,2013.
3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
4. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &Tensor Flow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019.

Reference Books:
1. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014.

4. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
5. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
6. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019
7. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

Web links and Video Lectures (e-Resources):

- NPTEL Video lectures: https://nptel.ac.in/courses/106105077
- NPTEL Video lectures: https://nptel.ac.in/courses/106102220
- https://archive.nptel.ac.in/courses/106/105/106105152
- https://archive.nptel.ac.in/courses/106/106/106106202
- https://nptel.ac.in/domains/discipline/106?course=106_0

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Group Discussion/Quiz
- Mini projects.

-

Sustainable Telecommunication Networks		Semester	V
Course Code	BTE515B	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory/practical/Viva-Voce /Term-work/Others		

Course objectives:
- Understand the basic concept of Sustainability..
- Analyse the principles of wireless networks.
- Understand the concepts of radiation standards.
- Understand the working of telecom regulatory bodies..
- Identify the different models for telecommunication networks.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Sustainability: Need for transformation, understanding today's telecommunication industry, business and sustainability, sustainability factors, green products, drivers of sustainability.

L1, L2

Module-2

Energy Efficiency and Management in Wireless Networks: Peer-to-Peer content sharing techniques for Energy Efficiency in Wireless Networks , Foraging-Inspired Radio-Communication Energy Management for Green Multi-Radio Networks, Intelligent Future Wireless Networks for Energy Efficiency, The telecom commercial communication, Internet of Things and data analytics in the cloud-sustainability, communication networks in IOT applications, Digital services and sustainable solutions, bandwidth management, energy management.

L1, L2

Module-3

Regulatory bodies: Telecom Regulations – Telecom Evolution, Role of regulatory bodies – The Indian perspective, TRAI Regulation 2022, The telecommunication Interconnection usage charges regulation, Access to Information Regulations on QoS for VOIP based ILD service, Broadcasting and cable services Interconnections, DTH services, Mobile number regulations.
L1, L2

Module-4
Radiation standards: Regulation of cellular service and RF radiation safety levels, SAR for cell phones, RFID standards, Wireless devices, ICNIRP, IEEE, CENELEC standards for controlled and occupational and military environments, Myths and Realities.   L1, L2

Module-5
Revenue models through Telecommunication Networks: Constant Revenue Model for Telecommunication Networks, Business Model Requirements and Challenges in the Mobile Telecommunication Sector, A Novel Dynamic Pricing Model for the Telecommunications Industry.   L1, L2, L3

Course outcome (Course Skill Set)
At the end of the course, the student will be able to :   1. Analyse the principles of wireless networks.   2. Understand and explain the need for sustainability, role of regulatory bodies, radiation hazards and revenue models for telecommunication network.   3. Apply the knowledge of radiation hazards to minimise the effect on human health and environment.   4. Apply the knowledge of financial management to arrive at effective revenue models for telecommunication networks.   5. Engage in a independent learning, submit a report and use ICT for effective presentation on the study on topics related to, Awareness on Mobile Tower Radiation & Its impact on Environment, human health and protection from radiation hazards.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
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- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:
 1. The Telecommunication Handbook, Kornel Tarplan, Patricia A Morreale, CRC Press.
 2. The Telecom Regulatory Authority of India Act, 1997, Georg Thieme Verlag.
 3. Telecommunication: New Signposts to Old Roads, Paul Slaa.
 4.Telecom Management in Emerging Economies: Evolutionary and Contemporary Perspectives, Murali Krishna Medudala, Mahim Sagar, Ravi Parkash Gandhi.

 Reference Books :
 1. Green Networking and Communications: ICT for sustainability, Shafiullah Khan, Jaime Lloret Mauri.
 2. Internet of Things and Data Analytics Handbook, Hwaiyu Geng, John Wiley & Sons.

Web links and Video Lectures (e-Resources):

- [Energy Scenario in Modern World - Part 2 | Sustainable Energy Technology (youtube.com)](youtube.com)
- [Lec 13 Energy harvesting - 01 (youtube.com)](youtube.com)
- [Wireless Networks Energy Efficiency: Best Practices (youtube.com)](youtube.com)
-

Data Structures using C++		Semester	5
Course Code	**BEC515C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:
- Learn the Basic Concepts of C++
- Describe the concepts of Pointers and Arrays
- Concepts of Data Structures
- Understanding of the implementation of a linked list and Algorithms

Teaching-Learning Process (General Instructions)
These are sample Strategies teachers can use to accelerate the attainment of the various course outcomes.
1. **Online coding platforms can be used to execute programs**
2. **Mobile applications can be used to execute the codes.**
3. **Presentation of concepts**

Module-1

UNIT-I: Software Engineering Principles And C++ Classes
Software Life Cycle, Software Development Phase, Classes.
Page No. 1-7, 17-33
OOD: Inheritance, Polymorphism, Templates
Page No. 60-78,84-112

UNIT-II: Pointers & Array based Lists
Pointer Data Type and Pointer Variables, Classes & Pointers, Inheritance Pointers &Virtual functions, Abstract Classes & Pure Virtual functions, Array Based Lists
Page No. 131-183

Module-2

UNIT-III: Linked Lists &Stacks
Linked List, Linked List as an ADT, Unordered Linked List, ordered Linked List, Doubly Linked Lists
Page No. 265-320
Stack: Stacks, Implementation of Stacks as Arrays , Linked Implementation of Stacks
Page No. 395-428

Module-3

UNIT-IV: Queues and Algorithms
Queue Operations, Implementation of Queues as Arrays, Linked Implementation of Queues, STL class queue, Priority Queues, Application of Queues: Simulation.
Page No. 451-490
Search Algorithms, Hashing, Sorting Algorithms: Selection sort, Insertion sort, Shell Sort.
Page No. 497-524,533-550

Module-4

UNIT-V: Binary Trees and B-Trees
Binary Trees, Binary Tree Traversal, Binary Search Trees, Binary Search Tree: Analysis, Non-recursive Binary Tree Traversal Algorithms, Binary Tree Traversal and Functions as Parameters, AVL (Height-Balanced) Trees, B-Trees
Page No. 599-675

Module-5
UNIT-VI: Graphs Introduction, Graph Definitions and Notations, Graph Representation, Operations on Graphs, Graphs as ADTs, Graph Traversals, Shortest Path Algorithm, Minimum Spanning Tree, Topological Order, Euler Circuits Page No.685-721

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Distinguish between procedures and object-oriented programming.

2. Apply advanced data structure strategies for exploring complex data structures.

3. Compare and contrast various data structures and design techniques in Performance.

4. Implement data structure algorithms through C++. Incorporate data structures into the applications such as binary search trees, AVL, and B Trees

5. Implement all data structures like stacks, queues, trees, lists, and graphs and compare their Performance and trade-offs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
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- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Text Book:

1.D.S.Malik - Data Structures using C++2nd Edition.

Reference Book

1. Sartaj Sahni – Data Structures, Algorithms, and Applications in C++ 2nd Edition

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106106127
- https://nptel.ac.in/courses/106102064
- https://nptel.ac.in/courses/106106133

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Students Can use Mobile applications/Online compilers/Code blocks to execute the programs and check output for different cases.

Satellite Communication		Semester	V
Course Code	BTE515D	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	
Examination type (SEE)	Theory/practical/Viva-Voce /Term-work/Others		

Course objectives:
- Understand the basic principle of satellite orbits and trajectories.
- Study of electronic systems associated with a satellite and the earth station.
- Understand the various technologies associated with the satellite communication.
- Focus on a communication satellite and the national satellite system.
- Study of satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Satellite Orbits and Trajectories: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle. [Text 1: 2.1,2.2,2.3,2.4,2.5,3.3,3.4,3.5,3.6,3.7]   L1, L2

Module-2

Satellite subsystem: Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload.
Earth Station: Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.
[Text 1: 4.1,4.5,4.6,4.7,4.8, 8.1,8.2,8.3,8.4,8.5,8.6,8.7]   L1,L2

Module-3

Multiple Access Techniques: Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA. Satellite Link Design Fundamentals: Transmission Equation, Satellite Link Parameters, Propagation considerations. [Text 1: 6.1,6.2,6.3,6.4,6.5,6.6, 6.7,6.9,6.12,6.13,6.14,7.1,7.2,7.4]   L1, L2, L3
Module-4
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems. [Text 1: 9.1,9.2,9.3,9.4,9.5,9.6,9.7,9.8,9.10]   L1, L2
Module-5
Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. **Weather Forecasting Satellites:** Fundamentals, Images, Orbits, Payloads, Applications. **Navigation Satellites:** Development of Satellite Navigation Systems, GPS system, Applications. [Text 1: 10.1,10.2,10.3]   L1, L2, L3
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Describe the satellite orbits and its trajectories with the definitions of parameters associated with it. 2. Describe the Electronic hardware systems associated with the satellite subsystem and earth station. 3. Describe the communication satellite with the focus on national satellite system. 4. Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques. 5. Describe the satellites used for applications in remote sensing, weather forecasting and navigation.

Assessment Details (both CIE and SEE)

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Semester-End Examination:

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3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Book:
1. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

Reference Books :
1. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

Web links and Video Lectures (e-Resources):
- https://nptel.ac.in/courses/117105131
- Basic Introduction To Satellite Communications | Satellite Communications - YouTube
- How Satellite Works (Animation) - YouTube