B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

REMOTE SENSING AND GIS

Course Code	**18CV651**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand the basic concepts of remote sensing.
2. Analyze satellite imagery and extract the required units.
3. Extract the GIS data and prepare the thematic maps.
4. Use the thematic camps for various applications.

Module-1

Remote Sensing: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.

Module-2

Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms-IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- introduction to digital data, systematic errors(Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity , Earth Rotation) and non-systematic [random] errors(Altitude, Attitude), Image enhancements(Gray Level Thresholding, level slicing, contrast stretching),image filtering.

Module-3

Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.

Module-4

Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, and Data conversion.

Module-5

Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services And Its Applications.

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

1. Collectdataanddelineatevariouselementsfromthesatelliteimageryusingtheirspectralsignature.
2. Analyze different features of ground information to create raster or vector data.
3. Perform digital classificationandcreatedifferentthematicmapsforsolvingspecificproblems
4. Make decision based on the GIS analysis on thematic maps.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Narayan Panigrahi, “Geographical Information Science”, and ISBN 10: 8173716285 / ISBN 13: 9788173716287, University Press2008.
2. Basudeb Bhatta, “Remote sensing and GIS” , ISBN:9780198072393, Oxford University Press2011
3. Kang – T surg Chang, “Introduction to Geographic Information System”. Tata McGraw Hill Education Private Limited2015.
4. Lilles and, Kiefer, Chipman,“RemoteSensingandImageInterpretation”,Wiley2011.

Reference Books:

1. Chor Pang Lo and Albert K.W Yeung, “Concepts &Techniques of GIS”, PHI,2006
2. John R. Jensen, “Remote sensing of the environment”, an earth resources perspective–2nd edition– by Pearson Education2007.
3. Anji Reddy M., “Remote sensing and Geographical information system”, B. S. Publications2008.
4. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, “Principals of Geo physical Information system”, Oxford Publications2004.
5. S Kumar,“Basics of remote sensing & GIS”, Laxmi publications 2005.

B. E. CIVIL ENGINEERING
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SEMESTER - VI

TRAFFIC ENGINEERING

Course Code	**18CV652**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand fundamental knowledge of traffic engineering, scope and its importance.
2. Describe basic techniques for collecting and analyzing traffic data, diagnosing problems, designing appropriate remedial treatment, and assessing its effectiveness.
3. Apply probabilistic and queuing theory techniques for the analysis of traffic flow situations and emphasis the interaction of flow efficiency and traffic safety.
4. Understand and analyse traffic issues including safety, planning, design, operation and control.
5. Apply intelligent transport system and its applications in the present traffic scenario.

Module-1

Traffic Planning and Characteristics: Road Characteristics-Road user characteristics, PIEV theory, Vehicle Performance characteristics, Fundamentals of Traffic Flow, Urban Traffic problems in India, Integrated planning of town, country, regional and all urban infrastructures, Sustainable approach- land use & transport and modal integration.

Module-2

Traffic Surveys: Traffic Surveys- Speed, journey time and delay surveys, Vehicles Volume Survey including non-motorized transports, Methods and interpretation, Origin Destination Survey, Methods and presentation, Parking Survey, Accident analyses-Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Level of service-Concept, applications and significance.

Module-3

Traffic Design and Visual Aids: Intersection Design- channelization, Rotary intersection design, Signal design, Coordination of signals, Grade separation, Traffic signs including VMS and road markings, Significant roles of traffic control personnel, Networking pedestrian facilities & cycle tracks.

Module-4

Traffic Safety and Environment: Road accidents, Causes, effect, prevention, and cost, Street lighting, Traffic and environment hazards, Air and Noise Pollution, causes, abatement measures, Promotion and integration of public transportation, Promotion of non-motorized transport.

Module-5

Traffic Management: Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, All segregation methods- Coordination among different agencies, Intelligent Transport System for traffic management, enforcement and education.

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

1. Understandthehumanfactorsandvehicularfactorsintrafficengineeringdesign.
2. Conductdifferenttypesoftrafficsurveysandanalysisofcollecteddatausingstatisticalconcepts.
3. Useanappropriatetrafficflowtheoryandtocomprehendthecapacity&signalizedintersectionanalysis.
4. Understand the basic knowledge of Intelligent Transportation System.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Kadiyali. L.R. “Traffic Engineering and Transport Planning ”, Khanna Publishers, Delhi,2013
2. S K Khanna and CEG Justo and AVeeraragavan, “Highway Engineering”, Nem Chand and Bros.
3. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management
4. Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan PressLtd.1996.

Reference Books:

1. Fred L. Mannering, Scott S. Washburn and Walter P. Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi,2011.
2. GarberandHoel,“PrinciplesofTrafficandHighwayEngineering”,CENGAGELearning,NewDelhi,2010.
3. SP: 43-1994,IRCSpecification,“Guidelineson Low-cost Traffic Management Techniques” for Urban Areas,1994.
4. John E Tyworth, “Traffic Management Planning, Operations and control”, Addison Wesly Publishing Company, 1996.
5. Hobbs.F.D.“Traffic Planning and Engineering”,University of Brimingham,Peragamon Press Ltd,2005.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

OCCUPATIONAL HEALTH AND SAFETY

Course Code	**18CV653**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Gainan historical, economic, and organizational perspective of occupational safety and health;
2. Investigate current occupational safety and health problems and solutions.
3. Identify the forces that influence occupational safety and health.
4. Demonstrate the knowledge and skills needed to identify work place problems and safe work practice

Module-1

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.

Module-2

Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations.

Module-3

Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers.
Electrical Safety, Product Safety: Technical Requirements of Product safety.

Module-4

Health Considerations at Work Place: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.

Module-5

Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.

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

1. Identifyhazardsintheworkplacethatposeadangerorthreattotheirsafetyorhealth,orthatofothers.
2. Controlunsafeorunhealthyhazardsandproposemethodstoeliminatethehazard.
3. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
4. Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
5. Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Goetsch D. L.,(1999), “Occupational Safety and Health for Technologists, Engineers and Managers”,

Prentice Hall.
2. HeinrichH.W.,(2007),"IndustrialAccidentPrevention-AScientificApproach",McGraw-HillBookCompany National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991),
3. "Industrial Safety and Pollution Control Handbook.

Reference Books:

1. CollingD.A.,(1990),"IndustrialSafetyManagementandTechnology",PrenticeHall,New Delhi.
2. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

SUSTAINABILITY CONCEPTS IN CIVIL ENGINEERING

Course Code	**18CV654**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Learn about the principles, indicators and general concept of sustainability.
2. Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
3. Student shall be able to apply the sustainability concepts in engineering
4. Know built environment frame work sand their use
5. Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

Module-1

Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Module-2

Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Module-3

Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Module-4

Clean Technology and Energy: Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.

Module-5

Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

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

1. Learn the sustainability concepts; understand the role and responsibility of engineers in sustainable development.
2. Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits.
3. Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.
4. Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Allen, D.T. and S honnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo, A. O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

Reference Books:

1. Mackenthun, K. M.,Basic Concepts in Environmental Management, Lewis Publication.
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Malcolm Dowden, Climate Change and Sustainable Development: Law, Policy and Practice.
6. Daniel A. Vallero and Chris Brasier, “Sustainable Design: The Science of Sustainability and Green Engineering”, Wiley-Blackwell.
7. Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers.

MOBILE APPLICATION DEVELOPMENT
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Course Code	**18CS651**	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	03

CREDITS –3

Course Learning Objectives: This course (18CS651) will enable students to:

- Learn to setup Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications

Module – 1	**Teaching Hours**
Get started, Build your first app, Activities, Testing, debugging and using support libraries **Textbook 1: Lesson 1,2,3** **RBT: L1, L2**	08
Module – 2	
User Interaction, Delightful user experience, Testing your UI **Textbook 1: Lesson 4,5,6** **RBT: L1, L2**	08
Module – 3	
Background Tasks, Triggering, scheduling and optimizing background tasks **Textbook 1: Lesson 7,8** **RBT: L1, L2**	08
Module – 4	
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders **Textbook 1: Lesson 9,10,11,12** **RBT: L1, L2**	08
Module – 5	
Permissions, Performance and Security, Firebase and AdMob, Publish// **Textbook 1: Lesson 13,14,15** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Create, test and debug Android application by setting up Android development environment
- Implement adaptive, responsive user interfaces that work across a wide range of devices.
- Infer long running tasks and background work in Android applications
- Demonstrate methods in storing, sharing and retrieving data in Android applications
- Analyze performance of android applications and understand the role of permissions and security
- Describe the steps involved in publishing Android application to share with the world

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks

- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details (Download pdf file from the above link)

Reference Books:

1. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
3. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
4. Anubhav Pradhan, Anil V Deshpande, " Composing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2

INTRODUCTION TO DATA SRUCTURES AND ALGORITHM
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Course Code	**18CS652**	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	03

CREDITS –3

Course Learning Objectives: This course (18CS652) will enable students to:

- Identify different data structures in C programming language
- Appraise the use of data structures in problem solving
- Implement data structures using C programming language.

Module 1	**Contact Hours**
Introduction to C, constants, variables, data types, input output operations, operators and expressions, control statements, arrays, strings, built-in functions, user defined functions, structures, unions and pointers **Text Book 1: Chapter 1 and 2** **RBT: L1, L2**	08
Module 2	
Algorithms, Asymptotic notations, Introduction to data structures, Types of data structures, Arrays. **Text Book 1: Chapter 3 and 4** **RBT: L1, L2**	08
Module 3	
Linked lists, Stacks **Text Book 1: Chapter 5 and 6** **RBT: L1, L2**	08
Module 4	
Queues, Trees **Text Book 1: Chapter 7 and 8** **RBT: L1, L2**	08
Module 5	
Graphs, Sorting ,(selection, insertion, bubble, quick)and searching(Linear, Binary, Hash) **Text Book 1: Chapter 7 and 8** **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Identify different data structures in C programming language
- Appraise the use of data structures in problem solving
- Implement data structures using C programming language.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Data structures using C , E Balagurusamy, McGraw Hill education (India) Pvt. Ltd, 2013.

Reference Books:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

PROGRAMMING IN JAVA
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Course Code	**18CS653**	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	03

CREDITS –3

Course Learning Objectives: This course (18CS653) will enable students to:

- Learn fundamental features of object oriented language and JAVA
- Set up Java JDK environment to create, debug and run simple Java programs.
- Learn object oriented concepts using programming examples.
- Study the concepts of importing of packages and exception handling mechanism.
- Discuss the String Handling examples with Object Oriented concepts

Module – 1	**Teaching Hours**
An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings **Text book 1: Ch 2, Ch 3** **RBT: L1, L2**	08
Module – 2	
Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements. **Text book 1: Ch 4, Ch 5** **RBT: L1, L2**	08
Module – 3	
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited, Inheritance: Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. **Text book 1: Ch 6, Ch 7.1-7.9, Ch 8.** **RBT: L1, L2**	08
Module – 4	
Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.	08

Text book 1: Ch 9, Ch 10 **RBT: L1, L2**	
Module – 5	
Enumerations, Type Wrappers, I/O, Applets, and Other Topics: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, Applet Fundamentals, The transient and volatile Modifiers, Using instanceof, strictfp, Native Methods, Using assert, Static Import, Invoking Overloaded Constructors Through this( ), String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String , Additional String Methods, StringBuffer, StringBuilder. **Text book 1: Ch 12.1,12.2, Ch 13, Ch 15** **RBT: L1, L2**	08
Course outcomes: The students should be able to:	
• Explain the object-oriented concepts and JAVA. • Develop computer programs to solve real world problems in Java. Develop simple GUI interfaces for a computer program to interact with users	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books:	
1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)	
Reference Books:	
1. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016. 2. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning Press, 1st Edition, 2014.	

INTRODUCTION TO OPERATING SYSTEM
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Course Code	**18CS654**	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	03

CREDITS –3

Course Learning Objectives: This course (18CS654) will enable students to:

- Explain the fundamentals of operating system
- Comprehend multithreaded programming, process management, memory management and storage management.
- Familier with various types of operating systems

Module – 1	**Teaching Hours**
Introduction: What OS do, Computer system organization, architecture, structure, Operations, Process, memory and storage management, Protection and security, Distributed systems, Special purpose systems, computing environments. System Structure: OS Services, User OSI, System calls, Types of system calls, System programs, OS design and implementation, OS structure, Virtual machines, OS generation, system boot **Textbook1: Chapter 1, 2** **RBT: L1, L2**	08
Module – 2	
Process Concept: Overview, Process scheduling, Operations on process, IPC, Examples in IPC, Communication in client-server systems. Multithreaded Programming: Overview, Models, Libraries, Issues, OS Examples **Textbook1: Chapter 3,4** **RBT: L1, L2**	08
Module – 3	
Process Scheduling: Basic concept, Scheduling criteria, Algorithm, multiple processor scheduling, thread scheduling, OS Examples, Algorithm Evaluation. Synchronization: Background, the critical section problem, Petersons solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors, Synchronization examples, Atomic transactions **Textbook1: Chapter 5, 6** **RBT: L1, L2**	08
Module – 4	
Deadlocks: System model, Deadlock characterization, Method of handling deadlock, Deadlock prevention, Avoidance, Detection, Recovery from deadlock Memory management strategies: Background, swapping, contiguous memory allocation,	08

paging, structure of page table, segmentation, **Textbook1: Chapter 7, 8** **RBT: L1, L2**	
Module – 5	
Virtual Memory management: Background, Demand paging, Copy-on-write, Page replacement, allocation of frames, Trashing, Memory mapped files, Allocating Kernel memory, Operating system examples File system: File concept, Access methods, Directory structure, File system mounting, File sharing, protection **Textbook1: Chapter 9, 10** **RBT: L1, L2**	08
Course outcomes: The students should be able to:	
• Explain the fundamentals of operating system • Comprehend process management, memory management and storage management. • Familiar with various types of operating systems	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books:	
1. A. Silberschatz, P B Galvin, G Gagne, Operating systems, 7th edition, John Wiley and sons,.	
Reference Books:	
1. William Stalling,"Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018. 2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016	

OPEN ELECTIVES-A OFFERED BY EC/TC BOARD

B. E. EC/TE
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VI

SIGNAL PROCESSING

Course Code	**18EC651**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8Hours/Module)**	**Exam Hours**	**03**

CREDITS – 03

Course objective: This course will enable students to:

- Understand, represent and classify continuous time and discrete time signals and systems, together with the representation of LTI systems.
- Ability to represent continuous time signals (both periodic and non-periodic) in the time domain, s-domain and the frequency domain
- Understand the properties of analog filters, and have the ability to design Butterworth filters
- Understand and apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time (without loss of information)
- Able to represent the discrete time signal in the frequency domain
- Able to design FIR and IIR filters to meet given specifications

Module-1	**RBT Level**
Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems **(Chapter 1)**	**L1, L2**
Module-2	
Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems, **(Chapter 3)**	**L1, L2**
Module-3	
Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications **(Chapter 8)**	**L1,L2, L3**
Module-4	
Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems. (FFT not included) **(Chapter 3, 4)**	**L1,L2, L3**
Module-5	
Definition of FIR and IIR filters. Frequency response of ideal digital filters Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response **(Chapter 8)**	**L1,L2, L3**

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

- Understand and explain continuous time and discrete time signals and systems, in time and frequency domain
- Apply the concepts of signals and systems to obtain the desired parameter/ representation
- Analyse the given system and classify the system/arrive at a suitable conclusion
- Design analog/digital filters to meet given specifications
- Design and implement the analog filter using components/ suitable simulation tools *(assignment component)*
- Design and implement the digital filter (FIR/IIR) using suitable simulation tools, and record the input and output of the filter for the given audio signal *(assignment component)*

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

'Signals and Systems', by Simon Haykin and Barry Van Veen, Wiley.

References:

1. 'Theory and Application of Digital Signal Processing', Rabiner and Gold
2. 'Signals and Systems', Schaum's Outline series
3. 'Digital Signal Processing', Schaum's Outline series

B. E. EC/TC
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VI

SENSORS and SIGNAL CONDITIONING

Course Code	**18EC652**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40 (08 Hrs/module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand various technologies associated in manufacturing of sensors
- Acquire knowledge about types of sensors used in modern digital systems
- Get acquainted about material properties required to make sensors

Module 1	**RBT Level**
Introduction to sensor bases measurement systems: General concepts and terminology, sensor classification, primary sensors, material for sensors, microsensor technology, magnetoresistors, light dependent resistors, resistive hygrometers,resistive gas sensors, liquid conductivity sensors **(Selected topics from ch.1 & 2 of Text)**	**L1, L2**
Module 2	
Reactance Variation and Electromagnetic Sensors: -Capacitive Sensors, Inductive Sensors, Electromagnetic Sensors. **Signal Conditioning for Reactance Variation Sensors**-Problems and Alternatives, ac Bridges Carrier Amplifiers, Coherent Detection, Specific Signal Conditioners for Capacitive Sensors, Resolver-to-Digital and Digital-to-Resolver Converters.	**L1, L2**
Module 3	
Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors.	**L2,L3**
Module 4	
Digital and intelligent sensors-position encoders, resonant sensors, sensors based on quartz resonators, SAW sensors, Vibrating wire strain gages, vibrating cylinder sensors, Digital flow meters.	**L2,L3**
Module 5	
Sensors based on semiconductor junctions -Thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge- coupled sensors – types of CCD imaging sensors, ultrasonic-based sensors.	**L2,L3**

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

- Appreciate various types of sensors and their construction
- Use sensors specific to the end use application
- Design systems integrated with sensors

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

"Sensors and Signal Conditioning", Ramon PallásAreny, John G. Webster, 2nd edition, John Wiley and Sons, 2000

Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

Transducers and Instrumentation

Subject Code	: 18EI651		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits - 3

Course Learning Objectives:

- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Classification and Functional Elements of Instrument/ measurement system:** Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments (Common to EIM), Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	8 Hours	L1, L2
Module -2 **Static and Dynamic Characteristics:** Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments. Dynamic response – dynamic characteristics, time domain analysis &different types of inputs, frequency domain analysis. Time domain response – zero order system, first order system, response of a first order system to step & ramp input, frequency response of first order system.	8 Hours	L1, L2, L3, L4

Module -3 **Measurement of Displacement:** Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, ultrasonic level detector, thermal level sensors	8 Hours	L1, L2, L3, L4
Module -4 **Measurement of Strain:** Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Strain gauge Circuits – Wheatstone bride circuit, Applications. **Measurement of Force & Torque**: Introduction, Force measuring sensor – Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, Electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type.	8 Hours	L1, L2, L3, L4
Module -5 **Measurement of Pressure**: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle & working, no derivation), force balance transducer with analysis, piezoelectric pressure transducer, pressure multiplexer, pressure calibration. **Miscellaneous Sensors**: Noise (sound) Sensors, Speed Sensors, Thickness Measurement.	8 Hours	L1, L2, L3, L4

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

- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments
- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

4. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
5. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4, Module 5 – Measurement of pressure)
6. Process Measurement Instrument Engineers Handbook- BelaG.Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement, Module 5- Miscellaneous Sensors)

Reference Books:

5. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
6. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
7. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
8. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

B.E. Electronics and Instrumentation Engineering
(EI) Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

Scientific and Analytical Instrumentation

(Common to EI, BM & ML)

Subject Code	**18EI652**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	02+02		SEE Marks	: 60
Total Number of Lecture Hours	40		Exam Hours	: 03

Credits - 3

Course Learning Objectives:

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To impart various spectroscopic techniques and its instrumentation.
- To impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **An Introduction to Instrumental Methods:** Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1). **IR Spectroscopy:** Basic Components of IR Spectrophotometers, monochromators- littrow mounting, Fourier Transform IR Spectroscopy (Text book 2).	08 Hours	L1, L2
Module -2 **UV and Visible Spectrometers –Instrumentation**: Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules(Text book 1), Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 2)	08 Hours	L1, L2
Module -3 **Flame Emission and Atomic Absorption Spectroscopy**: Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames & furnaces, applications, comparison of FES and AAS. (Text book 1).	08 Hours	L1, L2
Module -4 **Gas Chromatography:** Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column & capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2).	08 Hours	L1, L2, L3

HPLC Instrumentation: Mobile –phase delivery system sample introduction, separation of columns, Detectors–Ultraviolet Photometers & Spectrophotometers, electrochemical detector (amperometric detector), Differential refractometer. (Text book 1).		
Module -5 **Blood analyzer:** Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood pCO_2, pO_2 , A Complete blood gas analyzer. **Air pollution monitoring instruments:** Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO_2)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis, **Water pollution monitoring instruments**. (Text book 2)	08 Hours	L1, L2, L3, L4

Course Outcomes:

3. The students get well versed with the principle, construction and working of various analytical instrumentation.
4. Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Life-long Learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

3. Instrumental Methods of Analysis, 7th edition. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution (Module 1, Module 2, Module 3, Module 4HPLC)
4. Handbook of Instruments – R.S. Khandpur, Tata McGraw Hill (Module 1-IR Spectroscopy, Module 4, Module 5)

Reference Books:

4. Braun R.D., Introduction to Instrumental Analysis, McGraw –Hill Singapore,2006.
5. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.
6. Principles of Instrumental Analysis 5th Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

Lasers and Optical Instrumentation

Subject Code	: **18EI653**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Lasers -I: Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions**.**

Lasers -II: Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs.

Module -2

Generation of Lasers: Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold.

Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its Applications.

Module -3

Overview of Optical Fiber Communications: Motivations for light wave communications, optical spectral bands, Decibel units, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications.

Structures, Wave guiding, and Fabrication I: The nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory for circular waveguides, Single mode fibers.

Module -4

Structures, Wave guiding, and Fabrication II: Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fibers, Fiber optic cables.

Optical Amplifiers: Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System Applications, Raman amplifiers, wideband optical amplifiers.

Module -5

Applications of Fiber Optic Laser Systems in Medicine: Introduction, Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiber-optic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laproscopic laser surgery, photodynamic therapy inoncology, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopedics, laser lithotripsy, flowchart diagrams for clinical applications of laser-fiber systems-advances.

Textbook 3: Unit 9.1, 9.2, 9.2.1, 9.2.2, 9.2.5, 9.3.4, 9.5.2.3, 9.7.3, 9.8.2, 9.9.2, 9.11.4.3

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

6. Explain theprinciple and working of Laser system.
7. Discuss the engineering applications of laser systems.
8. Discuss the fundamentals of optical fiber communications.
9. Evaluate the design of optical fibers.

10. Apply fiber optic laser systems in medical field.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

4. Optoelectronics- An Introduction-Wilson & Hawkes, Prentice Hall of India.
5. Optical fiber communications-GeirdKeser, McGraw Hill education (India) private limited, Fifth edition.
6. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

Reference Books:

3. LASER Fundamentals- William T. Silfvast, Cambridge University Press.
4. Essentials of Opto Electronics with Applications - A.J. Rogers, CRC press 1997.

B. E. Industrial Engineering & Management
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

Course Code	**18IM651**	CIE Marks	40
Number of Lecture Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Credits – 03

Course Learning Objectives:

1. Will be able to understand about value
2. Can adopt functional approach in identifying unnecessary cost in a product
3. Can apply the value methodology
4. Can analysis value of the product and service and apply VA/VE technique to increase the value

Module-1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, Applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

TYPE OF VALUES: Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation.

Detailed case studies of simple products

Module-2

FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

PROBLEM SETTING & SOLVING SYSTEM: Goods system contains everything the task requires. Various steps in problem solving, case studies.

Module-3

VALUE ENGINEERING JOB PLAN: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgment phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

Module-4

VALUE ENGINEERING TECHNIQUES: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques.

ADVANCED VALUE ANALYSIS TECHNIQUES: Functional analysis system technique and case studies, Value analysis of Management practice(VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

TOTAL VALUE ENGINEERING: Concepts, need, Methodology and benefits.

Module-5

APPLICATION OF VALUE ANALYSIS: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

Course Outcomes: After the completion of the course, a student will

1. Able to understand the importance of value of a product
2. Find out unnecessary cost/ function involved in the product
3. Conduct value engineering methodology
4. Do value analysis using advanced value engineering techniques
5. Become a certified value engineer with additional course /training

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. Techniques of Value Analysis and Engineering– Lawrence D. Miles, McGraw – Hill Book Company, 2ndEdn.
2.Value engineering for Cost Reduction and Product Improvement – M.S. Vittal, Systems Consultancy Services Edn 1993
3.Value Management, Value Engineering and Cost Reduction – Edward D Heller Addison Wesley Publishing Company 1971

Reference Books:

1.Value Analysis for Better Management – Warren J Ridge American Management Association Edn 1969
2. Getting More at Less Cost (The Value Engineering Way) – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995
3.Value Engineering – Arther E Mudge McGraw Hill Book Comp. Edn 1981

B. E. Industrial Engineering & Management
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

DATA ANALYTICS FOR ENGINEERS

Course Code	**18IM652**	CIE Marks	40
Number of Lecture Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:
Understand data input and accessing data using R
Representation of data in graphical form
Analyzing data using probability and statistics
Inference of data using correlation and regression analysis.

Module-1

Introduction to R: Introduction R as a statistical software and language, R as a calculator, R preliminaries, Methods of data input, Data accessing or indexing, Some useful built-in functions, Graphics with R, Getting help, saving, storing and retrieving work, Exercises and solutions to exercises.

Module-2

Descriptive Statistics: Introduction, Diagrammatic representation of data, Graphical representation of data, Measures of central tendency, dispersion, skewness and kurtosis, Selection of representative samples, Exercises and solutions to exercises.

Module-3

Probability and probability distributions: Introduction, Probability: Definitions and properties, probability distributions, some special discrete distributions, continuous distributions, Exercises and solutions to exercises.

Module-4

Statistical Inference: Introduction, Sampling distribution of sample mean, Estimation of parameters, Plots to check normality, Hypothesis testing, Goodness of fit tests, Exercises and solutions to exercises.

Module-5

Correlation and Regression analysis: Introduction, Correlation, Inference procedures for correlation coefficient, Linear regression, Inference procedure for simple linear model, validation of linear regression model, Transformation of the variables, Polynomial regression models, Exercises and solutions to exercises.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Make use of various data analysis techniques and derive conclusions.
CO2: Make use of descriptive and inferential statistical techniques for data analysis.
CO3: Perform exploratory data analysis on a given set of data including visualization techniques.
CO4: Build regression models and use them for prediction.
CO5: Build time series models and use them for prediction.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1**"Statistics using R"**, Sudha G. Purohit, Sharad D. Gore and Shailaja R. Deshmukh, Narosa Publications, second edition -2015.

Reference Books:

1. "**R for Data Science**", Dan Toomey, PACKT Publishing, 2014.
2. "Practical Data Science wit R", Nina Zumel, John Mount, Manning Publications, 2014.
3. "Building a recommendation System with R", Suresh R Gorakala, Michelle Usuelli, PACKT Publishing, 2015.
4. "Learning Predictive Analytics with R", Eric Mayor, PACKT Publishing, 2015.
5. "Data Analytics with Open Source Tools", Philip K Janert, O'Reilly, 2010.
6. "Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber, Jian Pei, The Morgan Kaufmann Series in Data Management Systems, 3rd Edition, 2011.

B. E. Industrial Engineering & Management
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

ENGINEERING ECONOMY

Course Code	**18IM653**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- Define the fundamentals of engineering economics.
- Explain the concepts of decision making, problem solving, and comparison of the alternatives
- Demonstrate the understanding of concept depreciation and replacement analysis.
- Illustrate concept of money and its importance in evaluating the engineering projects.
- Evaluate the alternatives based on the present annual worth and equivalent annual worth methods.

Module-1

Introduction: Engineering decision – makers, engineering and economics, problem solving, intuition and analysis, tactics and strategy with an example.
Interest and Interest Factors: Interest rate, simple interest compound interest, interest formulae, time value equivalence exercises, problems and discussion.

Module-2

Present Worth Comparison: Conditions for present worth comparisons, rule 72, basic present worth comparisons, present worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems.

Module-3

Equivalent Annual Worth Comparisons: Situations for equivalent annual worth comparison, net annual worth of a single project, comparison of net annual worth's definitions of asset life, comparison of assets with equal and unequal lives, exercises and problems.

Module-4

Depreciation: Introduction, methods of depreciation, problems.
Replacement Analysis: Reasons- Deterioration, obsolescence, inadequacy, replacement criteria problems.

Module-5

Estimating and Costing: components of costs such as direct material cost, direct labor cost, Fixed, over – heads, factory costs, administrative – overheads, first cost, selling price, calculation of the total cost of various components, mensuration, estimation of simple components

Course Outcomes: At the end of the course the student will be able to:

6. Demonstrate the importance of Engineering Economy in engineering decision making.
7. Compare the various alternatives based on economy fundamentals.
8. Compare of asset life using net annual worth - assets with equal and unequal lives.
9. Apply concepts of depreciation and find the value of assets. Demonstrate skills in replacement decisions.
10. Estimate the cost of engineering operations and processes by determining the elements of cost.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	**Engineering Economy**	Riggs J.L	McGraw Hill,	2002
2	**Engineering Economy**	NVR. Naidu, KM Babu and	New Age InternationalPvt. Ltd	2006.
Reference Books				

3	**Engineering Economy**	Theusen.G	PHI,	2002
4	**Financial Management**	I M Pandey	Vikas Publishing House	2002.
5	**Engineering Economy**	Paul Degarmo	Macmillan Pub, Co.	2001

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –VI
OPEN ELECTIVE A

NON CONVENTIONAL ENERGY SOURCES

Course Code	**18ME651**	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To introduce the concepts of solar energy, its radiation, collection, storage and application.
- To introduce the concepts and applications of Wind energy, Biomass energy, Geothermal energy and Ocean energy as alternative energy sources.
- To explore society's present needs and future energy demands.
- To examine energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, etc.
- To get exposed to energy conservation methods.

Module-1

Introduction: Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind biomass, ocean temperature difference, tidal and waves, geothermal, tar sands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative).

Solar Radiation: Extra-Terrestrial radiation, spectral distribution of extra terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.

Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.

Module-2

Solar Radiation Geometry: Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples.

Radiation Flux on a Tilted Surface: Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples.

Solar Thermal Conversion: Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation, refrigeration. Distillation (Qualitative analysis) solar pond, principle of

Module-3

Performance Analysis of Liquid Flat Plate Collectors: General description, collector geometry, selective surface (qualitative discussion) basic energy-balance equation, stagnation temperature, transmissivity of the cover system, transmissivity – absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss coefficient, problems (all correlations to be provided). Temperature distribution between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expressions to be provided). Effect of various parameters on the collector performance; collector orientation, selective surface, fluid inlet temperature, number covers, dust.

Photovoltaic Conversion: Description, principle of working and characteristics, application.

Module-4

Wind Energy : Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples.

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, OTEC power stations in the world, problems associated with OTEC.

Module-5

Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, geothermal plants in the world, problems associated with geothermal conversion, scope of geothermal energy.

Energy from Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

Hydrogen Energy: Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production.

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

CO1: Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.

CO2: Know the need of renewable energy resources, historical and latest developments.

CO3: Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.

CO4: Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.

CO5: Understand the concept of Biomass energy resources and their classification, types of biogas Plants-applications

CO6: Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.

CO7: Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Non-Convention Energy Resources	B H Khan	McGraw Hill Education (India) Pvt. Ltd.	3rd Edition
2	Solar energy	Subhas P Sukhatme	Tata McGraw Hill	2nd Edition, 1996.
3	Non-Conventional Energy Sources	G.D Rai	Khanna Publishers	2003
Reference Books				
1	Renewable Energy Sources and Conversion Technology	N.K.Bansal, Manfred Kleeman&MechaelMeliss	Tata McGraw Hill.	2004
2	Renewable Energy Technologies	Ramesh R & Kumar K U	Narosa Publishing House New Delhi	
3	Conventional Energy Systems	K M, Non	Wheeler Publishing Co. Ltd., New Delhi	2003

4	Non-Conventional Energy	Ashok V Desai	Wiley Eastern Ltd, New Delhi	2003

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –VI
OPEN ELECTIVE A

WORLD CLASS MANUFACTURING

Course Code	**18ME652**	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To understand the concept of world class manufacturing, dynamics of material flow, and Lean manufacturing.
- To familiarize the students with the concepts of Business excellence and competitiveness.
- To apprise the students with the need to meet the current and future business challenges.
- To prepare the students to understand the current global manufacturing scenario.

Module-1

Historical Perspective World class Excellent organizations – Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence.

Module-2

Benchmark, Bottlenecks and Best Practices, Concepts of benchmarking, Bottleneck and best practices, Best performers – Gaining competitive edge through world class manufacturing – Value added manufacturing – Value Stream mapping – Eliminating waste –Toyota Production System –Example.

Module-3

System and Tools for World Class Manufacturing. Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping, Poka Yoke, 5-S,3 M, JIT, Product Mix , Optimizing , Procurement & stores practices , Total Productive maintenance, Visual Control.

Module-4

Human Resource Management in WCM: Adding value to the organization– Organizational learning – techniques of removing Root cause of problems–People as problem solvers–New organizational structures. Associates–Facilitators– Teamsmanship–Motivation and reward in the age of continuous improvement.

Module-5

Typical Characteristics of WCM Companies Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy.
Indian Scenario on world class manufacturing –Task Ahead. Green Manufacturing, Clean manufacturing, Agile manufacturing.

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

CO1: Understand recent trends in manufacturing.
CO2: Demonstrate the relevance and basics of World Class Manufacturing.
CO3: Understand customization of product for manufacturing.
CO4: Understand the implementation of new technologies.
CO5: Compare the existing industries with WCM industries.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Updated on 16.04.2020/28092020

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	World Class Manufacturing- Strategic Perspective	Sahay B.S., Saxena KBC. and Ashish Kumar	Mac Milan Publications	New Delhi
2	Just In Time Manufacturing	Korgaonkar M.G	MacMilan Publications	
Reference Books				
1	Production and Operational Management	Adam and Ebert	Prentice Hall learning Pvt. Ltd.	5th Edition
2	The Toyota Way – 14 Management Principles	Jeffrey K.Liker	Mc-Graw Hill	2003
3	Operations Management for Competitive Advantage	Chase Richard B., Jacob Robert	McGraw Hill Publications	11th Edition 2005
4	Making Common Sense Common Practice	Moore Ron	Butterworth-Heinemann	2002
5	World Class Manufacturing- The Lesson of Simplicity	Schonberger R. J	Free Press	1986

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –VI
OPEN ELECTIVE A

SUPPLY CHAIN MANAGEMENT

Course Code	**18ME653**	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To acquaint with key drivers of supply chain performance and their inter-relationships with strategy.
- To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.
- To study the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

Module-1

Introduction: Supply Chain – Fundamentals –Evolution- Role in Economy - Importance - Decision Phases – Supplier Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.

Module-2

Strategic Sourcing Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum -Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base- Supplier Development - World Wide Sourcing.

Module-3

Warehouse Management Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency-productivity-cost effectiveness-performance measurement.

Supply Chain Network Distribution Network Design – Role - Factors Influencing Options, Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models.

Module-4

Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees. Planning Demand, -multiple item -multiple location inventory management. Pricing and Revenue Management.

Module-5

Current Trends: Supply Chain Integration - Building partnership and trust in Supply chain Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. Supply Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpone the point of differentiation – IT in Supply Chain - Agile Supply Chains -Reverse Supply chain. Future of IT in supply chain- E-Business in supply chain.

Course Outcomes: At the end of the course the student will be able to:

CO1: Understand the framework and scope of supply chain management.

CO2: Build and manage a competitive supply chain using strategies, models, techniques and information technology.

CO3: Plan the demand, inventory and supply and optimize supply chain network.

CO4: Understand the emerging trends and impact of IT on Supply chain.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Supply Chain Management– Text and Cases	Janat Shah	Pearson Education	2009
2	Supply Chain Management- Strategy Planning and Operation	Sunil Chopra and Peter Meindl	PHI Learning / Pearson Education	2007
Reference Books				
1	Business Logistics and Supply Chain Management	Ballou Ronald H	Pearson Education	5th Edition, 2007
2	Designing and Managing the Supply Chain: Concepts, Strategies, and Cases	David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi	Tata McGraw-Hill	2005
3	Supply Chain Management- Concept and Cases	Altekar Rahul V	PHI	2005
4	Modeling the Supply Chain	Shapiro Jeremy F	Thomson Learning	Second Reprint , 2002
5	Principles of Supply Chain Management- A Balanced Approach	Joel D. Wisner, G. Keong Leong, Keah-Choon Tan	South-Western, Cengage Learning	2008

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –VI
OPEN ELECTIVE A

ADVANCED MATERIALS TECHNOLOGY

Course Code	**18ME654**	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To impart knowledge on material selection methods and basics of advanced engineering materials.
- To introduce the basics of smart materials, composite materials, ceramics and glasses and modern metallic materials and their applications in engineering.

Module-1

Classification and Selection of Materials: Classification of materials, properties required in Engineering materials, Selection of Materials; Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

Module-2

Composite Materials: Fiber reinforced, laminated and dispersed materials with metallic matrix of aluminium, copper and Titanium alloys and with non-metallic matrix of unsaturated polyesters and epoxy resins. Development, Important properties and applications of these materials.

Module-3

Ceramics and Glasses - Bio-ceramics: Nearly inert ceramics, bio-reactive glasses and glass ceramics, porous ceramics; Calcium phosphate ceramics: grafts, coatings Physico-chemical surface modification of materials used in medicine.

Low & High Temperature Materials: Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.

Module-4

Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides.

Non-metallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers.

Module-5

Smart Materials: Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications.

Nanomaterials: Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials.

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

CO1: Explain the concepts and principles of advanced materials and manufacturing processes.

CO2: Understand the applications of all kinds of Industrial materials.

CO3: Apply the material selection concepts to select a material for a given application.

CO4: Define Nanotechnology, Describe nano material characterization.

CO5: Understand the behaviour and applications of smart materials, ceramics, glasses and non-metallic materials.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books				
1	Engineering Material Technology	James A. Jacobs & Thomas F. Kilduff	Prentice Hall	
2	Materials Science and Engineering	WD. Callister Jr.	Wiley India Pvt. Ltd	2010
3	Engineering Design: A Materials and Processing Approach	G.E. Dieter	McGraw Hill	1991
4	Materials Selection in Mechanical Design	M.F. Ashby	Pergamon Press	1992
5	Introduction to Engineering Materials & Manufacturing Processes	NIIT	Prentice Hall of India	
6	Engineering Materials Properties and Selection	Kenneth G. Budinski	Prentice Hall of India	
7	Selection of Engineering Materials	Gladius Lewis	Prentice-Hall, New Jersey	

OPEN ELECTIVE-A

B.E (OPEN TO ALL PROGRAMMES OF ENGINERRING)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

OPEN ELECTIVE-A

LASER PHYSICS AND NON-LINEAR OPTICS (18PHY651)

Course Code	**18PHY651**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:
This course will

- Enable the students to understand the mode of working of different types of Laser with relevant theoretical background
- Benefit to identify the applications of laser in various fields
- Support to learn the fundamentals of optical fiber materials and various fabrication methods
  Assist to recognize the relevance of NLO in Laser technology and learn its fundamentals

Module-1

Theory of Vibrations and Resonance:
Equation for simple harmonic motion, Differential equation for SHM, Free vibrations, natural frequency of vibration, Damped vibration, Analytical treatment of Damped vibration, Cases of Over damping, critical damping & Under damping, Forced Vibrations, Analytical treatment of forced vibrations, condition for resonance, sharpness of resonance, Applications of resonance: Takoma Bridge collapse, Laser cavity resonance. Numerical problems.

Module-2

Laser:
Review of basic principles, Types of Laser: Nd-YAG Laser, Liquid Laser, Dye Laser (Rhodamine 6-G), Chemical Laser (HF Laser), Qualitative discussion of Free electron Laser and X-ray Laser, Laser amplifiers.
Numerical problems.

Module-3

Applications of Lasers:
Defence applications: Laser range finder and Laser guided antitank missile,
Industrial applications: Data storage and Laser printing,
Research and development applications: Lithography, Laser cooling, Laser fusion and isotope separation.
Detection of pollutants in the atmosphere using laser (LIDAR)
Biomedical applications: Eye surgery, Endoscopy and Dentistry

Module-4

Optical Fiber Communication:
Review of basic principles of Optical fibers, fiber materials, fiber fabrication, Vapor-deposition methods, Fiber optic cables, optical fiber connections, joints and couplers, attenuation and dispersion in optical fibers, Industrial, medical and technological applications of optical fiber, Fiber optic sensors -Intensity modulated, phase modulated and polarization modulated sensors.
Numerical problems.

Module-5

Nonlinear Optics:
Relevance of Nonlinear optics in Laser technology, descriptions of nonlinear optical processes, formal definition of the nonlinear susceptibility, nonlinear susceptibility of a classical anharmonic oscillator, properties of the nonlinear susceptibility, time-domain description of optical nonlinearities, Mention of Kramers–Kronig relations in linear and nonlinear optics. The wave equation for nonlinear optical media, sum-frequency generation, second-harmonic generation, difference-frequency generation and parametric amplification¸ optical parametric oscillators.
Numerical problems.

Course outcomes: At the end of the course the student will be able to:

CO 1: Distinguish and analyze different types of vibrations.
CO 2: Understand fabrication and working of different types of Lasers.
CO 3: Learn the applications of Lasers in various fields.
CO 4: Acquire the knowledge of optical fibers and their applications in sensor designing.
CO 5:Apprehend the basics of nonlinear optics phenomena through the fundamentals of quantum mechanics

Question paper pattern:

The question paper will be set for 100 marks and the marks obtained by the student is reduced to 60

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Engineering Physics	R. K. Gaur and S. L. Gupta	Dhanpath Rai and Sons	2006
2	Lasers: Theory and Applications	K. Thyagarajan and A.K. Ghatak	Springer	1981
Reference Books				
3	Laser and Fundamentals	W. T. Silfvast	Cambridge University Press	2004
4	Essentials of Nonlinear optics	Y.G.S. Murthy and C. Vijayan	Wiley Publications	2012
5	Lasers and Nonlinear optics	B. B. Laud	John Wiley & Sons Inc	2014

B.E (OPEN TO ALL PROGRAMMES OF ENGINERRING)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

OPEN ELECTIVE-A

APPLIED CHEMISTRY FOR ENGINEERS

Course Code	**18CHE652**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- This course will explore applications of chemistry which includes polymers, surfactants, nanomaterials, environmental and green chemistry, biomolecules and analytical techniques.

Module-1

Polymers: Introduction, types of polymerisation. Mechanism of polymerization of ethylene. Molecular weight, numerical problems. Glass transition temperature – Crystallinity, melting point. Viscoelasticity. Elastomers-structure, applications and curing. Conducting polymers and applications. Solubility of polymers. Fabrication and moulding of polymers. Synthesis, properties and uses of PVC, PMMA. Resins: Synthesis, properties and uses of urea - formaldehyde and phenol - formaldehyde. Composites: types and applications. Metallic and nonmetallic fillers.

Module-2

Surfactants and Lubricants: Methods of preparation, cleaning mechanism. Critical micelle concentration and its determination. Hydrophobic and hydrophilic interactions. Micelles and reverse micelles. Detergents. Fricohesity of surfactants. Lubricants-physical and chemical properties, types and mechanism of lubrication. Additives of lubricants and freezing points of lubricants.

Corrosion: Thermodynamic overview of electrochemical processes. Reversible and irreversible cells. Chemical and electrochemical corrosion and mechanism of corrosion. Factors affecting corrosion. Protection of corrosion and practical problems of corrosion.

Module-3

Nanomaterials: Introduction to nanomaterials. Properties and applications of fullerenes, fullerols, carbon nanotubes and nanowires. Synthesis-top down and bottom up approaches. Nanoelectronics. Applications of nanomaterials in catalysis, telecommunication and medicine.

Metals and Alloys: Phase rule and applications of one, two and multi-component systems. Iron-carbon phase diagram. Types of alloys, carbon steel, alloy steel, alloys of Cu, Al, Pb.

Module-4

Environmental and Green Chemistry: Air, water and noise pollution. Optimum levels of pollution. Significance and determination of COD and BOD. Solid waste treatment of collection of NKP. Greenhouse effect/global warming. e-Waste. Radioactive pollution. Applications of green chemistry and green technology. Concept of atomic and molecular economy and its use in green chemistry.

Modern Analytical Techniques: Mass spectrometry. Thermal analysis. Electron microscopy, scanning tunneling microscope and atomic force microscope. Sensors. Lab-on-a-chip.

Module-5

E**nergy Science:** Petroleum refining, liquid fuels, anti-knock agents. Cracking of oils. Limitations of fossil fuels. Alternative and non-conventional sources of energy – solar, wind, geo, hydro-power and biomass. Advantages and disadvantages. Nuclear energy, reactors and nuclear waste disposal. Safety measures for nuclear reactors.

Course Outcomes: At the end of the course, students are able to:

CO1: Apply the principles of Polymer Chemistry in industrial applications.
CO2: Understand the structures of different types of molecules in lubrication and corrosion
CO3: Distinguish between nanomaterials, metals and alloys.
CO4: Use classical methods of gravimetric and volumetric analysis through analytical techniques.
CO5: Apprehend the need of non-conventional energy sources.

Question paper pattern:

Note:- The SEE question paper will be set for 100 marks and the marks scored by the student will be proportionately reduced to 60.

- The question paper will have **ten** full questions carrying equal marks.
- Each full question carries **20** marks.
- There will be **two** full questions (with a **maximum** of **three** sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.

The students will have to answer **five** full questions, selecting **one** full question from each module

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Nano Science	S. M. Lindsay	Oxford	2009
2	A Textbook of Engineering Chemistry	Shashi Chawla	Dhanpat Rai & CO	2013
Reference Books				
3	Engineering Chemistry	P. C Jain and M. Jai	Dhanpat Rai & CO	2013
4	Advanced Polymer Chemistry	M. Chanda	New York : Marcel Dekker	2000
5	A Textbook of Environmental Chemistry	O. D. Tyagi and M. Mehra	Anmol Publications Pvt Ltd	1990

B.E (OPEN TO ALL PROGRAMMES OF ENGINERRING)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

OPEN ELECTIVE-A

ADVANCED LINEAR ALGEBRA

Course Code	**18MAT653**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	**3**	Exam Hours	03

Course Learning Objectives:

- To familiarize the important tools of linear algebra, that are essential in all branches of engineering.
- To develop the knowledge/skills of linear transformation and decomposition techniques in a comprehensive manner.

Module-1

Linear Equations: Consistent and inconsistent systems and its solution sets; LU-decomposition.
Vector Spaces: Vector spaces; subspaces; Linearly independent and dependent vectors; Bases and dimension; coordinate vectors; computations concerning subspaces-Illustrative examples.

Module-2

Linear Transformations: Linear transformations; algebra of transformations**;** representation of transformations by matrices; linear functional; Non singular Linear transformations**;** inverse of a linear transformation; Problems on Rank-Nullity theorem.

Module-3

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and orthogonal projections; Gram-Schmidt orthogonalization process; QR- decomposition.

Module-4

Introduction to Spectral Theory: Eigen values and eigenvectors; Diagonalization; quadratic Forms, constrained optimization; Singular value decomposition.

Module-5

Engineering Applications:
i**)** Graphs and Networks (Article No:10.1, P.No:452-461, Text No. 2).
ii) Matrices in Engineering (Article No:10.2, P.No:462-473, Text No. 2).
iii) Computer Graphics.(Article No:10.9, P.No:596-602, Ref No. 3).

Course outcomes: At the end of the course the student will be able to:

CO1: Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices.
CO2: Apply various numerical methods for solving linear partial differential equations arising in engineering field.
CO3: Develop expansion of functions of complex variables in terms of Laurent's series, explain ideas related to the calculus of residues and contour integration.
CO4: Understand the facts related hypothesis testing and analyze the analysis of variancefor larger samples.
CO5: Apply the knowledge of stochastic process, queuing theory, in solving problems arising in various physical and engineering phenomena.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbook/s				

1	Linear Algebra and its Applications	David C. Lay	Cambridge University Press	3rd Edition, 2017.
2	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	5th Edition, 2016.
Reference Books				
3	Introductory Linear Algebra with Applications	Bernard Kolman and David R. Hill	Pearson Education (Asia) Pvt. Ltd	7th Edition, 2003
4	Linear Algebra	Kenneth Hoffman andRay Kunze	Pearson Education (Asia) Pte. Ltd, 2004.	2nd Edition, 2004
5	Elementary Linear Algebra - Applications Version	Howard Anton and Chris Rorres	Wiley, 2014	11th Edition, 2014