Jharkhand University of Technology, Ranchi

B. Tech. First Year

Tentative Revised Curriculum/Syllabus

Branch: EE, EEE, ECE, CSE, IT, Cybersecurity, (Data Science)

Semester: I

Session: 2023-2024

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S. No.	Course Code	Course Title	L	T	P	J*	Cr	Categorisation
01	BSM01	Engineering Mathematics I	3	1	0	06	4	BSC
02	BSP01	Engineering Physics	3	0	2		4	BSC
03	ESEE1	Basics of Electrical Engineering	2	0	2		3	ESC
04	ESEM1	Engineering Mechanics	3	0	2		4	ESC
05	ESPP1	Programming for problem solving	2	0	2		3	ESC
06	HSM01	Indian Knowledge System	2	0	0		2	IKS
07	VSC01	Data Visualization and Pre-processing	0	0	2		1	VSEC
08	CCA01	Sports/NSS/NCC/YOGA/Painting/Music/Classical dance	0	0	2		1	CCA
Total			15	01	12	06	22	

Semester II

S. No.	Course Code	Course Title	L	T	P	J*	Cr	Categorisation
01	BSM02	Engineering Mathematics II	3	1	0	06	4	BSC
02	BSC02	Engineering Chemistry	2	0	2		3	BSC
03	BSB02	Biology for Engineers	2	0	0		2	BSC
04	ESEL2	Elements of Electronics Engineering	2	0	2		3	ESC
05	ESED2	Engineering Drawing and Computer Graphics	1	0	4		3	ESC
06	PCEL2	Fundamentals of measurement and sensors	2	0	2		3	PCC
07	HSM02	Communication Skills#	0	0	2		1	AEC
08	CCA02	Sports/NSS/NCC/YOGA/Painting/Music/Classical dance	0	0	2		1	CCA
09	INT02	Summer Internship@	Min 4 Weeks				2	
Total			12	01	14	06	22	

L: Lecture, T: Tutorial, P: Practical/Field Survey/Summer training/Internship/Physical activity/ co-curricular activity etc, J*: GD/Seminar/Workshop/Personality development/Soft skills/Studio activity (alternate day), Cr: Credit

* Department will assign a faculty under J.

One faculty of Humanities and one faculty of concerned department.

@ for every 20 students one faculty will be assigned by the concerned department.

Note:

Exit option to qualify for Certification (Any three skill based courses):

EOPCB: Printed Circuit Board (PCB) Design and Production (3 Credits) activity

EOELW: Electrical Workshop (3 Credits)

EOINW: Instrumentation Workshop (3 Credits)

EOCPP: Python Programming (3 Credits)

BSM01 Engineering Mathematics I

Course Outcomes:
Students should be able to

1. **Apply** concepts of linear algebra in physical and engineering problems.
2. **Develop** the essential tool of matrices and linear algebra in a comprehensive manner.
3. A**nalyze** the dynamics of real world problem using concept of Differential Calculus of two or more variables.
4. **Evaluate** the volume and surface area of the solid using double and triple integral.
5. **Familiarize** the students with line, surface and volume integral using Green's, Gauss and Stoke's theorem in different field of Science and Engineering such as electromagnetic theory and fluid dynamics.

Unit 1
Matrices and Linear Algebra:
Matrices: Elementary operations, Gauss Elimination, Rank of matrices: Echelon form, Normal form, Determinants, Consistency and solution of system of linear equations, Eigen values, Eigen vectors, Caylay-Hamilton theorem. Vector space, subspace, linearly independent and dependent of vectors. Basis and Dimensions, Rank-Nullity theorem.
S: Basic properties of matrices, Elementary transformation, Determinants.

Unit 2
Differential Calculus:
Expansions of function of one variable using Taylor's and Maclaurin's series, Asymptotes, Curve tracing, Limit and continuity of two variables, Partial and Total derivatives, chain rule, Jacobian, Taylor's theorem, Maxima and minima of two variables, Method of Lagrange's multipliers.
S: Higher order derivatives, Limit and continuity of two variables, Jacobian.

Unit 3
Integral Calculus:
Beta and Gamma function, Evaluation of Double integrals in Cartesian and Polar co-ordinates, Change of order of integration, Evaluation of Triple integrals in Cartesian, Spherical and Cylindrical co-ordinates, Change of Variables, Applications to Area, Volume, surface area and Center of Mass. Vector differentiation, Gradient, Divergence and Curl, Line Integrals and Arc Length Parameterization, Surface Integral, Volume Integral, Path independence, Statements and illustrations of theorems of Green, Stokes and Gauss, applications.
S: Beta and Gamma function, Area, Volume, Surface area.

Textbooks:
1. Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley Eastern Ltd.
Reference Books:
1. Serge Lang, "Linear Algebra" Springer , 3rd edition
2. Gilbert Strang," Linear Algebra and its applications", Cengage Learnings RS, 4th edition
3. Howard Anton and Chris Rorres ,"Elementary Linear Algebra ",John Wiley, and sons, 10th edition
4. K. D. Joshi , "Calculus for Scientists and Engineers" , CRC Press
5. Sudhir Ghorpade and Balmohan Limaye , "A course in Calculus and Real Analysis"1st edition, Springer-Verlag, New York.

BSP01 Engineering Physics

Course Outcomes:

Students should be able to

1. Apply the concepts of Quantum mechanics to one dimensional motion of electrons
2. Classify solids on the basis of Band theory and to calculate carrier concentrations
3. Evaluate the electrical conductivity and identify the type of semiconductor
4. Implement the fundamentals of LASER for different applications

Unit 1

Quantum Mechanics: Matter waves, Properties of matter waves, Physical significance of wave function. Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box), Electron in a finite deep potential well (non-rigid box)

Unit 2

Solid State Physics: Lattice parameters, Miller indices, inter planer distance of lattice plane, density of crystals (linear, planar and volume), S*o*mmerfield's free electron theory, Density of states (3D), Fermi-Dirac probability function, Nearly free electron theory (E-k curve), classification of solids on the basis of band theory

Unit 3

Semiconductor Physics: Electron and hole concentrations in semiconductors, intrinsic density, intrinsic and Extrinsic conductivity, Position of Fermi level in intrinsic and extrinsic semiconductors, Law of mass action, Temperature variation of carrier concentration in extrinsic semiconductors, Electrical conduction in extrinsic semiconductor, Hall Effect

Unit 4

Laser Physics: Introduction to laser, Spontaneous and stimulated emission of radiations, Thermal equilibrium, Condition for Light amplification, Population inversion, Pumping (Three level and four level pumping), Optical resonator, Laser beam characteristics, Ruby laser, Nd-YAG Laser, He-Ne Laser, Semiconductor Laser, Engineering applications of Laser (Fiber optics, Laser material interaction)

Learning resources:

1. Introduction to quantum mechanics / David J. Griffiths
2. A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
3. Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
4. Introduction to Solid State Physics, Charles Kittel, Wiley.
5. Solid State Physics, S. O. Pillai, New Age International Publishers.
6. Solid state electronic devices, Ben G. Streetman, Sanjay Banerjee Pearson Prentice- Hall.
7. LASERS Theory and Applications, K. Thyagarajan, A. K. Ghatak; Macmillan India Ltd.
8. Mechanical Vibrations Theory and Applications, Francis S. Tse, Ivan E Morse, Rolland T. Hinkle

BSPP1: Engineering Physics Laboratory

Course Outcomes:

Students should be able to

1. Calculate energy gap, carrier concentration and mobility of the given material.
2. Verify quantum mechanical phenomena.
3. Estimate the size of the object using Laser diffraction.
4. Determine the magnetic susceptibility and dielectric constant of the material

List of Experiments:

1. Frank-Hertz Experiment
2. Planck's Constant
3. To determine the wavelengths of light of a given source using diffraction grating
4. Band gap of a semiconductor by four probe method
5. Hall effect in Semiconductor
6. Magnetoresistance measurement of semiconductor
7. To determine the reverse saturation current and material constant of PN Junction
8. To determine the dielectric constant of material
9. Study of Biot-Savart's law
10. Measurement of magnetic susceptibility by Quinke's method

Course Objectives:

1. To provide an experimental foundation for the theoretical concepts introduced
2. To achieve hands-on experimental skills and the study of practical applications will bring more confidence.

ESEE1 Basics of Electrical Engineering

Course Outcomes

At the end of the course, students will demonstrate the ability to

1. Analysis of AC and DC circuits.
2. Apply the principles of electric and magnetic circuits to solve engineering problems.
3. Analysis and acquire knowledge about transformer.
4. To understand the basics of rotating electrical machines.
5. Use of relevant protective devices for electrical installations.

Unit1

DC Circuits: Electrical circuit elements (R, L, and C), voltage and current sources, Kirchhoff's laws, analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, Star-Delta transformation

Unit2

AC Circuits:

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power.

Unit3

Magnetic Circuits and Transformers: Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Autotransformer and three-phase transformer connections

Unit4

Rotating Electrical Machines: Construction, types, characteristics and applications of DC motors. Three-Phase induction motors, principle of operation, construction, types, slip and application.

Unit5

Electrical Wiring and Safety: Types of wires and cables, Copper conductor sizes and rating, earth wires, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, UPS types and specifications. Electrical safety measures, safety practices, Earthing and its importance, first aid treatment after electrical shock, basic concept of electric grid.

Textbooks:

1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd Edition2019
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,4th Edition,2019

Reference Books:

1. Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2nd Edition, 2003.

ESEP1 Basics of Electrical Engineering

List of Experiments:

1. Overview of the Basic Electrical Engineering Lab and safety precautions.
2. To verify Network Theorems: KCL, KVL and Superposition Theorems
3. To connect a simple DC circuit with two loops and more than one source and to measure all the branch currents and node voltages.
4. To verify Thevenin's and Norton's Theorems.
5. To measure voltage, current, and power in the R-L, R-C and R-L-C series circuits and observe the phase difference between voltage and current using CRO.
6. To connect three-phase induction motor in star and delta and measure line and phase voltages and currents to verify the relationship between line and phase quantities.
7. To determine the efficiency and regulation of a single-phase transformer by direct loading.
8. Starting, reversing and speed control of DC motor.
9. Starting and reversing of three-phase induction motor and measurement of slip at different load conditions.
10. To connect the single-phase load bank through a switch-fuse unit, MCB and ELCB and check their operation in case of overload, short circuit, and earth leakage.
11. To study different types of earthing.
12. To study electrical sub-station.

ESEM1 Engineering Mechanics

Course Outcomes:

Students should be able to

1. Apply Mechanics principles to find resultant and equilibrium of 2D force system
2. Evaluate forces in statically determinate trusses and cables using equations of static equilibrium
3. Apply laws of dry friction for engineering problems
4. Solve engineering problems on motion of a particle

Unit 1

Force system: Forces, Free-Body Diagrams, Moment, Couples, Resultant and Equilibrium of Two dimensional force System, Equivalent Force system

Unit 2

Structures in Equilibrium: Beams and Trusses, Dry Friction for inclined planes, Belt friction

Unit 3

Motion of a Point: Position, Velocity and Acceleration, Straight Line motion, Curvilinear Motion, Cartesian coordinates, normal & tangential coordinates and, polar coordinates. Relative motion

Unit 4

Forces, Mass and Acceleration: Newton's second law, Work-Energy Principle, Impulse- Momentum Principle, Direct central impact.

Textbooks:

1. Hibbeler R. C., "Engineering Mechanics - Statics", Prentice Hall ,14th Edition
2. Hibbeler R. C., "Engineering Mechanics - Dynamics", Prentice Hall ,14th Edition
3. Beer F. P., Johnston E. R. et al., "Vector Mechanics for Engineers: Statics Dynamics", McGraw-Hill Publication, 12th Edition

Reference Books:

1. Meriam J. L., Kraige L. G., "Engineering Mechanics - Statics ", John Wiley and Sons, 8th Edition
2. Meriam J. L., Kraige L. G., " Engineering Mechanics - Dynamics ", John Wiley and Sons, 8th Edition
3. Bedford and W. Fowler, "Engineering Mechanics - Statics and Dynamics", Pearson Publications

ESMM1: Engineering Mechanics Laboratory

Course Outcomes:

Students will demonstrate the ability to:

1. Verify principles of mechanics through experiments.
2. Solve simple engineering problems using graphical solution techniques.
3. Solve simple engineering problems using computer programs.

PART A: Experiments (Any six)

1. Verification of law of polygon of forces
2. Verification of law of moments
3. Study of Space force system
4. Determination of beam reactions
5. Belt friction
6. Determination of shear force and bending moment of beam
7. Verification of Newton's second law of motion
8. Moment of inertia of flywheel
9. Coefficient of friction
10. Simple machine (Screw Jack)
11. Stiffness of spring
12. Young's Modulus

PART B: Assignments

There will be six assignments, based on graphical and computer solutions of Engineering Mechanics problems. Each assignment shall have a minimum of two problems.

ESPP1 Programming for Problem Solving

Course Outcomes:

Students should be able to

1. Represent real life data using data types and variables provided by programming language.
2. Write flow chart, using standard notation, for given problems.
3. Solve a given problem using expressions, conditional statements, arrays and loops.
4. Design a modular solution using functions, by breaking down the problem into parts, using programming language.
5. Demonstrate the ability to process files of various types.

Unit1

Understanding a problem:

Framing a problem in simple terms – mathematical, graphical, other abstractions. Number systems. Syntax errors and runtime errors. Manual solutions to real life problems. Algorithms, Properties/characteristics of Algorithms, Flowchart and Pseudo code, Algorithmic representation of the solutions

Basic steps in program execution: Editing, compiling/interpreting/running programs, OS view and programmer's view.

Unit 2

Introduction to problem solving using computers:

Basic Problems: Basic Data types (Numerical, String). Variables. Expressions. Statements. I/O statements for keyboard handling. Decision Making Statements (if-Statements, if-else Statements, Nested if Statements, Multi-way if-elif-else Statements), Conditional statements, Exchange values of two variables. Finding maximum of three numbers.

Unit 3

Iterative Problems without arrays: Introduction to iterative constructions in language. Find Sum, average of a given set of numbers. Loop design techniques: While loop - body, iterative step, loop condition. Emphasis on while loop against for loop. Factorial. Sine function computation. Fibonacci sequence generation. Some problems to read data from files.

Array techniques: Arrays as homogenous collection of elements. Array properties. Reversing elements of an array.Finding maximum. Finding second maximum. Algorithms for substring search.

Search problems: linear search. linear search in sorted array. Binary search.

Unit 4

Modular Solutions

Functions: Introduction to functions. Importance of design of functions. Rewriting earlier solutions using functions. Taking care of all possible values of arguments, Parameters, return values, signature, local and global scope, Modular code, Reusability.

Unit 5

Recursion:

Basic rules of recursion: recursive formulation, terminating case, handle all cases, recursion leading to terminating case. Factorial: iterative vs. recursive.

Recursive formulation for: multiplication, gcd, towers of Hanoi, binary search. Recursion vs. iteration in general.When to use recursion.

Unit 6

Sorting: Insertion, Bubble, selection sorts

Textbooks:

1.R. G. Dromey, "How to solve it by Computer", Pearson Education, ISBN 0-13-433995-9
2.Maureen Sprankle, "Problem Solving and Programming Concepts", Pearson Education, ISBN-978-81-317-0711-1

Reference Books:

1.Stephen G. Krantz, “Problem Solving Techniques” , Universities Press.
2.Kernighan and Ritchie, “The ‘C’ programming language”, Prentice Hall
3.Reema Thareja, “Python Programming: Using Problem Solving Approach”, Oxford University Press; First edition, 978-0199480173

ESCP1 Programming for Problem Solving

The course involves writing code for solved, unsolved and practice programming problems given in the lab manual.

List of suggested experiments

1. Write a program to enter two numbers and perform all arithmetic operations.
2. Program to find area of a triangle using Heron’s Formula
3. Take two integers as input and divide the first by the second. Prevent division by zero.
4. Write a program to print `n' terms of an Arithmetic series, with the first term `a' and a constant difference `d'. Take `a,d,n' from user.
5. Take a real value `x' from the user and find the value of tan (x), log (x), square root of x
6. Write a program to display all the prime numbers between 1 and 100
7. Write a program to take as input, 10 integers and put them in an array and display their values. Then, find the sum of all elements in the array and the position of the largest element. (Hint: use the logic of the algorithm to find maximum)
8. Declare a 3x3 matrix. Initialize it to zero using nested loops. Then fill some user- given values into it. Print the matrix in proper format to make sure the inputs are correctly taken.
9. Write your own function to find the minimum element of an array of integers. (Input to the function is integer array, output is the position number of the minimum element)
10. Declare an array of 10 integers. Declare a pointer and point it to the base of the array. Print all the elements of the array using this pointer and not using the original name of the array.
11. Write a program to sort a given set of structures on a given key-pair, using bubble sort.
12. Write a recursive function to raise a number to a given power.

HSM01 Indian Knowledge System

Unit 1		
Basics of Ancient Indian Knowledge and Diverse Fields from Health (Yoga), Agriculture, Performing Arts etc.	:	Yoga - Patanjali and Panini, Yoga Sutras & Mahabhashya, Yoga from Ancient Rishis, Munies, Sages and Seers, Different types of Yogas, Asanas & Pranayamas, Vagbhata Samhita for Health Benefits. Agriculture - Ancient Agricultural Trends, Practices & means of Transportation in Agriculture. Performing Arts – Different types of Ancient Arts, i.e; Murtikala, Embossing in Jewellery, Different School of Arts in Ancient India : Mathura, Gandhara and Amravati School, Pottery & Utensil making from Mud.
Unit 2		
Ancient Indian Knowledge in Various Science Streams like Physics, Chemistry, Biology, Forestry, Mathematics etc.	:	Gravitational Laws, Concept of Pendulum, Ancient knowledge of Space & Astronomy related to Outer Space and different Celestial Bodies, i.e; Planetary System, Stars and their Movement. Chemistry – Ancient Knowledge of Rasayanas, Preservative Methods using Oil and Salt etc. Biology & Forestry – Rich Cultural Heritage of Ayurveda, Different types of Medicinal uses of Plants, Fauna, Flora. Study of Animal and Plant Fossils, Interaction/ Inter-relation of Mankind and Nature on Mutually Beneficial Basis. Traditional methods for conservation of Forests, Trees and Preventing Soil Erosion. Mathematics – Present Day Decimal System traces its History to Ancient India, Giving the concept of Zero as a number to the World, Negative Numbers, basic Arithmetic and Algebraic concept, Knowledge of Advance Trigonometry in Ancient India.
Unit 3		
Ancient Indian Knowledge in Civil Engineering, Metallurgy, Mechanical Sciences, Textile Technology etc	:	Civil Engineering Concept and Familiarity with Sthapaty Kala, the Art of Construction in Ancient India, Civil Engineering Knowledge in Architecture in Making a Well Planned City by the Harappan Civilization Remains Undisputed. World Heritage Sites of Ajanta, Ellora, Khajuraho, Sanchi, Mahabalipuram are the Testaments of Excellent Civil Engineering Craftsmanship and Architecture, Well Developed Architecture During Cholas, Pal Dynasty is Evident in Various Ancient Temples in Present India. Concept of Canals and Wells for Irrigation & Human Needs in Ancient India is Well Documented Metallurgy – Concept Well Mentioned in Vedic Age Texts Using the Term Ayas for Metals, Minting/ Metal Casting Of Gold, Silver, Bronze, Copper for Utensils and Jewellery During Ancient India. Mechanical Sciences – Agriculture and Military Equipments like Hammer, Tongs, Idea of Basic Mechanical Concept for Transportation Using Bullock-Carts, Handpulled Carts Using Wheels, Chariots, Boats Using Patwar (Rudder) During Vedic Age ss Well Known, Use of Ploughing Tools Made of Metals and Wood etc. Textile Technology – Archaeological Evidence of Cotton Textile at Mohenjo Daro in the Indus Valley, Use of Charkhas and Traditional Yarns like Khadi, Silk Fabric from Silk Worm and export of quality Silk to West and European Countries is well established.
Unit 4		
Ancient Indian Knowledge in Electrical, Electronics, Computational Studies, Instrumentation etc.	:	Ancient India Knowledge in Generation of Electricity from Water, Silk and Clouds, Agastya Samhita Speaks about Electroplating, Basic knowledge of Computations and Instrumentation during Vedic Period, Musical Instruments like Seven-Holed Flute and other Stringed Instruments like Ravanahatha, Cymbals, Dhol (Drum) found by Archaeologists from Indus Valley Civilization Sites.

VSC01 Data Visualization and Pre-processing

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify the importance of data visualization and pre-processing
2. Select and use appropriate visualization Techniques
3. Apply data visualization techniques for analysing the data
4. Interpret results of exploratory data analysis.
5. Apply different pre-processing techniques on data

Unit 1

Introduction to data visualization: Data and Information, Types of data, Quantitative or Categorical data, Collection of Data, Representation of Data. Overview of data visualization and its importance, advantages and disadvantages. Data visualization steps.

Unit 2

Data Visualization Techniques: Graphs and charts for categorical data, bar charts, line plots, scatter plots, pie chart, Scatter plots, histograms, interactive data visualization.

Unit 3

Data Visualization Tools: Tableau, Looker, Microsoft Excel (and Power BI), google charts. Top data visualization Libraries, Different types of graphs and charts in data visualizations.

Unit 3

Introduction to Data Pre-Processing: Importance of data pre-processing operations, Challenges and issues. Data pre-processing techniques (data cleaning, data integration, data reduction, Data Reduction Strategies).

Textbooks:

1. Kieran Healy, “Data Visualization: A Practical Introduction”, Princeton University Press 2018.
2. Dr. Shirshendu Roy, “Data Visualization: Using Power Bi Orange and Excel”, Notion Press, 2021.
3. Daniel Garfield, “Data Pre-processing: Enhancing Data for analysis. The Art of Pre-processing”, 2023

Reference Books:

1. Min Chen, Helwig Hauser, Penny Rheingans, “Gerik Scheuermann,‘Foundations of Data Visualization”, Springer, 2020
2. Andy Kirk, “Data Visualization: A Handbook for Data Driven Design” , SAGE Publication, 2019
3. Alexandru C. Telea, “Data Visualization: Principles and Practice”, CRC Press, 2014
4. Stephen Few, “Information Dashboard Design: Displaying Data for At-a-Glance Monitoring”, Analytics Press; 2nd edition , 2013
5. Ben Fry, “Visualizing data: Exploring and explaining data with the processing environment”, O'Reilly, 2008
6. Pang-Ning Tan, Michael Steinbach, Vipin Kumar “Introduction to Data Mining”, Pearson Addison-Wesley, Second Edition

List of Experiments:

1. Download any free data set (from tableau/kaggle etc)in excel format and prepare the following:
   bar charts, area chart ,pie charts ,line plots, scatter plots
2. Download any free data set and prepare the following: Heat map, Tree map, Histogram
3. Study of any of the visualization tools like Tableau, Power BI, Domo, Excel
4. Use of Python libraries such as Matplotlib, Seaborn, Plot to visualize data in the given dataset
5. Prepare a Dashboard using any one sourse software e.g. Tableau, Microsoft POWER BI, Google data Studio
6. Install WEKA on your system and study different features
7. Use WEKA tool for feature extraction and filtering

Resources:

- Kalilur Rahman, 'Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh, BPB Publication, 2021
- Ryan Sleeper, 'Practical Tableau'O'Reilly Media Inc, 2018
- Bostjan Kaluza, 'Instant Weka How-to', Packt Publishing, 2013

CCA01

Sports/NSS/NCC/YOGA/Painting/Music/Classical dance