GOKUL GLOBAL UNIVERSITY

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Bachelor of Engineering

Computer Engineering

Under

Choice Based Credit System (CBCS)

Faculty of Engineeering
Hansaba College of Engineering & Technology
University Campus, State Highway-41, Siddhpur - 384151, Dist. Patan, Gujarat, INDIA
E: dean.fac.engg@gokuluniversity.ac.in W: www.gokuluniversity.ac.in M: +91 95109 73860

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	I	FEB110001	Engineering Mathematics-I	5(3+2+0)	Basic Science Courses
2	I	FEB110202	Elements of Mechanical Engineering	5(4+0+2)	Engineering Science Courses
3	I	FEB110003	Communication Skill	4(3+1+0)	Humanities & Social Science including Management Courses
4	I	FEB110304	Elements of Electrical Engineering	5(4+0+2)	Engineering Science Courses
5	I	FEB110005	Physics	4(3+0+2)	Basic Science Courses
6	I	FEB110206	Basic Workshop	2(0+0+4)	Engineering Science Courses
7	I	FEB110007	Induction Program	0(0+0+4)	Audit
TOTAL				**25**	

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	II	FEB120001	Engineering Mathematics - II	5(4+1+0)	Basic Science Courses
2	II	FEB120302	Basic Electronics	4(3+0+2)	Engineering Science Courses
3	II	FEB120403	Computer Programming With C	5(4+0+2)	Engineering Science Courses
4	II	FEB120204	Engineering Graphics	5(3+0+4)	Engineering Science Courses
5	II	FEB120105	Environmental Science (Mandatory Course)	0(2+2+0)	Mandatory Course
TOTAL				**19**	

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	III	FEB130001	EffectiveTechnicalCommunication	3(2+0+2)	Humanities & Social Sciences Including Management Courses
2	III	FEB130002	Indian Constitution	0(2+0+0)	Mandatory Courses
3	III	FEB130401	Engineering Mathematics-III (Differential Calculus)	4(3+0+2)	Basic Science Courses
4	III	FEB130402	Digital Electronics	4(3+0+2)	Professional Core Courses
5	III	FEB130403	Object Oriented Programming with C++	5(3+0+4)	Professional Core Courses
6	III	FEB130404	Data structure & Algorithms	4(3+0+2)	Engineering Science Courses
TOTAL				**20**	

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	IV	FEB140001	Essence of Indian Traditional knowledge	0(3+0+0)	Mandatory Course
2	IV	FEB140401	Discrete Mathematics	4(3+0+2)	Professional Core Courses
3	IV	FEB140402	Computer Organization	4(3+0+2)	Professional Core Courses
4	IV	FEB140403	Operating Systems	5(3+0+4)	Professional Core Courses
5	IV	FEB140404	Design & Analysis of Algorithms	4(3+0+2)	Professional Core Courses
6	IV	FEB140405	Database Management Systems	4(3+0+2)	Professional Core Courses
TOTAL				**21**	

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	V	FEB150001	EE&M (Humanities II)	3 (3+0+0)	Humanities & Social Sciences Including Management Courses
2	V	FEB150401	System Programming	4 (3+0+2)	Professional Core Courses
3	V	FEB150402	Object Oriented Programming with Java	5 (3+0+4)	Professional Core Courses
4	V	FEB150403	Micro Processor & Interfacing	4 (3+0+2)	Engineering Science Course
5	V	-	Elective-I	5 (3+0+4)	Professional Elective Courses
TOTAL					**21**

Elective I	
FEB150404	Web Technology
FEB150405	Computer Graphics

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	VI	FEB160401	Theory of Computation	3 (3+0+0)	Professional Core Courses
2	VI	FEB160402	Computer Networks	4 (3+0+2)	Professional Core Courses
3	VI	FEB160403	Software Engineering	4 (3+0+2)	Professional Core Courses
4	VI	-	Elective-II	4 (3+0+4)	Professional Elective Courses
5	VI	-	Open Elective-I	3 (0+2+2)	Open Elective Courses
6	VI	FEB160407	Project - I	3 (0+0+6)	Project
TOTAL					**21**

Elective II	
FEB160404	Advance Java
FEB160405	Data Science

Open Elective - I	
FEB160001	Cyber Security
FEB160406	Internet of Things

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	VII	FEB170401	Compiler Design	3 (2+0+2)	Professional Core Courses
2	VII	-	Elective-III	4 (3+0+2)	Professional Elective Courses
3	VII	-	Elective-IV	4 (3+0+2)	Professional Elective Courses
4	VII	-	Open Elective-II	3 (0+2+2)	Open Elective Courses
5	VII	FEB170410	Project-II	6 (0+0+12)	Project
TOTAL					**20**

Elective III	
FEB170402	Data Mining & Business Intelligence
FEB170403	Mobile Computing with Android
FEB170404	Distributed DBMS

Elective IV	
FEB170405	.NET Technology
FEB170406	Distributed Operating System
FEB170407	Big Data Analytics

Open Elective – II	
FEB170408	Python Programming
FEB170409	Embedded System

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	VIII	-	Elective-V	4 (3+0+2)	Professional Elective Courses
2	VIII	-	Elective-VI	4 (3+0+2)	Professional Elective Courses
4	VIII	FEB180407	Project-III	10 (0+0+20)	Project
TOTAL					**18**

Elective – V	
FEB180401	Artificial Intelligence
FEB180402	Soft Computing
FEB180403	Web Data Management

Elective VI	
FEB180404	Information & Network Security
FEB180405	Cloud Computing
FEB180406	iOS Programming

FEB110001: ENGINEERING MATHEMATICS-I

Objective:students are intended to know about the basic concepts and principles of Mathematics as a tool to analyse the Engineering problems. Mathematics has the potential to understand the Core Technological studies.

Credit:5 **Semester IL-T-P:3-2-0**

Sr.	Content	Total Hrs	% Weightage
1	Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, Taylor's and Maclaurian's theorems and their examples, Indeterminate forms and L' Hospital Rule, Improper integrals, Convergence and divergence of improper integrals, Beta and Gamma functions and their properties. Applications of definite integrals to evaluate surface areas and volumes of revolutions.	**09**	**15%**
2	Convergence and divergence of sequence, tests for convergence of sequence: The Sandwich Theorem, The continuous function theorem and bonded monotonic sequence Convergence and divergence of series, tests for convergence of Series: Comparison test, Cauchy's integral test, De' Alembert's ratio test, Cauchy's root test, Leibniz's rule for alternating series, Power series, Radius of convergence of power series, Taylor's and Maclaurian's series. Fourier Series of periodic functions, Fourier Series of even and odd functions, Half range sine and cosine series, Parseval's theorem.	**10**	**25%**
3	Limit and continuity of function of several variables, partial derivatives, directional derivatives, total derivatives, Chain rule, derivatives of implicit functions, Euler's theorem on homogeneous functions, Taylor's and Maclaurin's expansion for function of two variables, Extrema of function of several variables, Application of Lagrange method of undetermined multipliers, Tangent plane and normal line	**10**	**25%**

4	Multiple Integration: Double integrals, change of order of integration, Change of variables, Applications: areas and volumes Triple integrals, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Jacobian, Multiple integral by substitution	**08**	**15%**
5	Algebra of Matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem	**08**	**20%**

Reference Books:

1. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.
2. Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.
3. James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
4. Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.

Course Outcome:

CO-1: To apply differential and integral calculus to improper integrals and to determine applications of definite integral. Apart from some other applications they will have a basic understanding of indeterminate forms, Beta and Gamma functions

CO-2: To apply the various tests of convergence to sequence, series and the tool of power series and Fourier series for learning advanced Engineering Mathematics

CO-3: To compute directional derivative, maximum or minimum rate of change and optimum value of functions of several variables

CO-4: Mathematics has the potential to understand the core Technological studies

CO-5: To compute the areas and volumes using multiple integral techniques

CO-6: To perform matrix computation in a comprehensive manner

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	2	3	-	1	2	-	3	2	-	2	3
CO-2	3	-	2	1	3	-	1	2	3	1	-	2
CO-3	3	1	3	2	-	1	1	2	-	2	1	3
CO-4	3	2	-	-	3	2	2	-	3	3	2	3
CO-5	-	1	2	2	-	1	-	2	3	1	-	3
COR-6	1	-	-	3	2	1	-	2	2	2	2	3

FEB110202: ELEMENTS OF MECHANICAL ENGINEERING

Objective: Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

Credit:5 **L-T-P:4-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction:** Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.	4	25%
2	**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion	3	
3	**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process	5	
4	**Properties of Steam:** Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters	6	30%
5	**Heat Engines:** Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles	5	
6	**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, Functioning of different mountings and accessories		
7	**Internal Combustion Engines:** Introduction, Classification, Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies	4	20%
8	**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming	3	

9	**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistage	**3**	
10	**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners	**4**	**25%**
11	**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc)	**3**	
12	**Transmission of Motion and Power:** Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive	**4**	

References Books:

1. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
2. Basic Mechanical Engineering by Pravin Kumar, Pearson
3. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi
4. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication
5. Introduction to Engineering Materials by B.K. Agrawal Tata Mcgraw Hill Publication, New Delhi

Course Outcome:

After learning the course the students should be able to

CO1 To understand the fundamentals of mechanical systems

CO2 To understand and appreciate significance of mechanical engineering in different fields of engineering

CO3 Enhancement of fundamental knowledge of Thermodynamics

CO4 Enhancement of fundamental knowledge of Fluid Mechanics and I.C. Engines

CO5 Acquiring knowledge of materials and their properties for engineering applications

CO6 Evaluate properties of steam. Demonstrate various types of boilers and their relative merits and demerits. Learning problem solving in particular domain.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	-	2	2	2	2	2	2	-	2
CO-2	3	2	3	-	2	2	3	-	3	3	2	-
CO-3	3	-	-	-	3	2	2	-	2	2	-	-
CO-4	3	2	2	1	2	-	3	2	-	1	-	-
CO-5	3	3	3	2	2	1	2	1	-	-	-	-
CO-6	3	2	3	2	3	2	2	1	1	-	-	-

FEB110003: COMMUNICATION SKILL

Objective: Objective of this curriculum is to help students refresh their knowledge of English language. It also targets the understanding of grammar, focusing on comprehension, and reading, speaking and writing skills. This would be developed through balanced and integrated tasks.

Credit:2**L-T-P:3-1-0**

Sr.	Content	Total Hrs	% Weightage
1	Communication skills Process, types and levels of communication. Technical Communication and General Communication. Factors to be considered in technical communication	4	25%
2	Verbal and non-verbal communication (kinesics) Components of Non- verbal Communication (Kinesics) Barriers to effective communication. (Noise in oral and written communication) Communication across cultures.	3	
3	Listening skills - Types of Listening Active Listening V/s Passive Listening Empathetic Listening. Traits of a good listener, barriers in effective listening, Tips for effective listening.	5	
4	Effective presentation strategies. Defining purpose, analysis of audience and locate, organizing contents. Repairing an outline of the presentation. Visual aids, nuances of delivery, Body language and effective presentation.	6	30%
5	Interviews Introduction, General preparations for an interview, Types of questions generally asked at the interviews. Types of interviews, Importance of nonverbal aspects.	5	20%
6	Group Discussions Introduction, Group discussions as a part of the selection process, guidelines for group discussion. Role functions in group discussion.	4	
7	Letter - Writing Business Letters, Structure and types of a business letter, Letter of Inquiry, Letters of complaint, regret and	3	

	adjustment.		
8	Technical reports Introduction, types of reports, structure of reports, objectives and characteristics of reports.	**3**	
9	Technical Proposals Definition, Purpose, Types, Characteristics, Structure, Style and appearance.	**4**	**25%**
10	Effective Reading Skills Purpose of reading, skimming and scanning. Tips for improving comprehension skills.	**3**	
11	Job application Essential parts - Cover Letter and the 'resume'. Types of 'resumes' (Curriculum Vitae) Chronological 'resume', functional 'resume'.	**4**	

Reference Books:

1. Technical English, Dr. M. Hemamalini, Wiley.2014
2. Practical English Usage, Michael Swan, OUP.1995
3. Remedial English Grammar, F.T. Wood, Macmillan. 2007
4. Oxford Language Reference, (Indian Edition) OUP
5. On Writing Well, William Zinsser, Harper Resource Book.2001
6. Study Writing, Liz Hamp-Lyons and Ben Heasly, Cambridge University Press.2006
7. Communication Skills, Sanjay Kumar and Pushp Lata, Oxford University Press.2011
8. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford UniversityPress
9. The Study of Language, George Yule, CUP, 4th Edition.2010
10. A Course in English Phonetics, T R Kansakar, Orient Longman.1998
11. Spoken English, R K Bansal and J B Harrison, Orient Longman. 2013 Course Outcome: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Outcome:

CO-1: Use various forms of vocabulary in varied situations in oral and written communication.

CO-2: Understand the phonetics and the transcription pattern to learn correct pronunciation

CO-3: Comprehend the dynamics of various rules of grammar and check its validation while they speak and write language correctly.

CO-4: Use grammar effectively to make themselves competent Listener, Speaker, Reader and Writer by exposing to various set of situations.

CO-5: Write various formal and informal documents of day to day life and professional set up.

CO-6: Demonstrate the qualities of writing in diverse situation by using the nuances such as conciseness, clarity, accuracy, organization, and coherence.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	2	1	3	-	2	3	2	2	2	2
CO-2	3	2	-	-	3	1	-	3	1	-	1	1
CO-3	3	2	2	3	3	2	2	1	3	2	-	3
CO-4	3	-	1	2	2	3	1	3	-	2	-	3
CO-5	3	3	-	1	1	3	3	-	2	-	2	2
CO-6	3	1	3	-	-	1	1	3	1	3	2	3

FEB110304: ELEMENTS OF ELECTRICAL ENGINEERING

Objective: The course provides introductory treatment of the field of Electrical Engineering & Electronics to the students of various branches of engineering.

Credit:5 **L-T-P:4-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction of D.C. Circuits :** Introduction, Ohm's Law,Application of Kirchhoff's Law,Nodal Analysis, Mesh Analysis, Series-Parallel Of Resistance, Ideal and Practical Energy Sources, Line Regulation and Load Regulation, Source Transformation, Star-Delta Transformation, Temperature Co-efficient,	**8**	**15%**
2	**Electrostatic &Capacitor:** Electric charge and Laws of electrostatics; Definitions - Electric field, lines of force, electric field intensity, electric flux and flux density; Electrostatic induction; Gauss's law and its application; Dielectric strength; Capacitor; Capacitor in series and parallel, Energy stored in a capacitor.	**6**	**10%**
3	**Electro Magnetics:** Faradays Laws; Lenz's Law; Fleming's Rules; Effect of magnetic field on current carrying conductor; Magnetic circuits; Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Inductance in series and parallel; Hysteresis and Eddy current losses; Energy stored in magnetic fields.	**8**	**15%**

4	**Single Phase A.C. Circuits:** Generation of sinusoidal voltage, Definition of average value, root mean square value, form factor and peak factor; Phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, R-L, R-C and R-L-C circuits; Concepts of Real power, Reactive power, Apparent power and Power factor, Series, Parallel and Series - Parallel circuits; Power in AC circuit, Power factor improvement; Resonance in series and parallel circuits, Q-factor, Bandwidth and Selectivity.	**20**	**30%**
5	**Three Phase A.C. Circuits:** Necessity and Advantages of three phase systems, Generation of three phase power, Phase sequence, Balanced supply and Balanced load; Relationship between line and phase values of balanced three phase circuit; Power Measurement in balanced three phase circuits. Measure 3-Phase power bye watt-mater methods.	**8**	**15%**
6	**Batteries and Fuel Cell:** Introduction of Batteries; The Simple cell, E.M.F and internal resistance of a cell; Primary and Secondary cells, Cell capacity; Types & Specifications of Batteries; Charging & Discharging of Battery; Safe disposal of Batteries; Fuel cell: Principle & Types of fuel cell.	**2**	**5%**
7	**Electrical Wiring & Illumination:** Types of wires and cables; Types of Connectors & Switches; System of wiring, domestic and industrial wiring; Simple control circuit in domestic installation. Types of lamps, fixtures & reflectors; Illumination schemes for domestic, industrial & commercial premises; Lumen requirements for different categories.	**2**	**5%**
8	**Safety & protection:** Safety precautions in handling electrical appliances; Electric shock, First aid for electric shock other hazards of electrical laboratories & safety rules; Grounding & Earthling - Importance of grounding and earthing, equipment for grounding, Methods of	**2**	**5%**

	earthling; Circuit protection devices: Fuses, MCB, ELCB & Relays.		

References Books:

1. B.L.Theraja (2012), Electrical Technology,Vol – 1,S. Chand.
2. D.P. Kothari and I.J. Nagrath (2013), Theory and Problems in Basic Electrical Engineering,Prentice Hall, India.
3. Parker Smith (2003), Problems in Electrical Engineering, CBS Publishers
4. Introduction to Electrical Engineering, M S Sarma, Oxford University Press

Course Outcome:

After Completion Of The Course , The Student Will Be Able To-

CO-1: Understand electrical current, potential difference, power and energy, sources of electrical energy, resistance and its behavior with temperature.

CO-2: Use the Ohm's Law and the Kirchhoff's Law and star delta transformation for solving resistive series, parallel and series-parallel circuits.

CO-3: Define Electric field, lines of force, electric field intensity, electric flux, flux density and permittivity. Capacitor, charging and discharging phenomena of capacitors and calculations of capacitance for capacitors connected in series and parallel circuits.

CO-4: Understand Concepts of Real power, Reactive power, apparent power and Power factor and perform calculations of these quantities for series and parallel R-L-C circuits.

CO-5: Understand the importance of safety and the precaution to be taken while working with electrical equipment and accessories. Understand the working principle, usage and construction of circuit protection devices such as fuse, MCB, ELCB & Relays

CO-6: Design simple analog signal processing functions using operational amplifiers.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	-	-	2	3	2	2	2	3	1	1
CO-2	2	2	2	3	2	-	-	1	-	2	-	-
CO-3	2	3	-	2	2	2	2	-	-	2	-	-
CO-4	3	2	3	1	1	-	-	-	-	-	-	-

CO-5	2	2	2	2	-	-	-	-	-	2	-	-
CO-6	-	2	2	2	2		-	1	-	2	3	-

FEB110005: PHYSICS

Objective: Engineering, being the science of measurement and design, has been offspring of Physics that plays the primary role in all professional disciplines of engineering.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**MODULE 1: ELECTRONIC MATERIALS** • Free electron theory • Density of states and energy band diagrams, • Kronig-Penny model (to introduce origin of band gap), • Energy bands in solids, • E-k diagram, Direct and indirect bandgaps, • Types of electronic materials: metals, semiconductors, and insulators, • Density of states, Occupation probability, • Fermi level, Effective mass, Phonons.	**8**	**22%**
2	**MODULE 2: SEMICONDUCTORS** • Intrinsic and extrinsic semiconductors • Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics) • Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, • Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices	**10**	**27%**
3	**MODUL-3 LIGHT SEMICONDUCTOR INTERACTION** • Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; • Joint density of states • Density of states for photons, • Transition rates (Fermi's golden rule) • Optical loss and gain; Photovoltaic effect, Exciton • Drude model.	**06**	**17%**
4	**Module 4: Measurements** • Four-point probe and Van Der Pauw measurements for carrier density,	**06**	**17%**

	• Resistivity and hall mobility • Hot-point probe measurement, capacitance-voltage • measurements, • Parameter extraction from diode I-V characteristics, DLTS, • band gap by UV-Vis spectroscopy, absorption/transmission.		
5	**Module 5: Superconductivity** • Introduction of Superconductivity • Properties of superconductor • Effect of magnetic field • Meissner effect • Pressure effect • Impurity effect • Isotopic mass effect • Mechanism of Superconductivity : BCS Theory • Penetration depth : Magnetic field • Josephson's junction and its application • Application of superconductors	**06**	**17%**

Reference Books:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc.
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc.
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India
6. Engineering Physics by Dattu R Joshi, McGraw hill Publications.

Course Outcome:

CO-1: The student will demonstrate the ability to think in core concept of their engineering application by studying
various topics involved in branch specific applications.
CO-2: The student will demonstrate understanding of basic theory, properties and applications of Superconductivity.
CO-3: The student will gain knowledge of basic theoretical and mathematical concept of electronic materials.

CO-4: The student will demonstrate understanding of basic principles, properties and applications associated with
semiconducting materials.

CO-5: The student will demonstrate understanding of basic theory and properties associated with optoelectronic
materials.

CO-6: The student will demonstrate understanding of basic principles, properties, type and application Lasers.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	2	2	-	2	2	2	2
CO-2	3	3	2	2	-	2	2	-	-	-	2	1
CO-3	3	3	2	2	3	2	-	-	1	2	3	1
CO-4	3	3	2	2	-	2	2	-	-	-	2	1
CO-5	3	3	2	2	-	2	2	-	-	-	2	1
CO-6	3	2	2	2	2	2	2	-	-	2	2	2

FEB110206: BASIC WORKSHOP

Objective: Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

Credit:2**L-T-P:0-0-4**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction:** Workshop layout, Importance of various sections/shops of workshop, Types of jobs done in each shop, General safety rules and work procedure in workshop	**6**	**15%**
2	**Fitting:** Select appropriate fitting tools for the Required application, Prepare the simple jobs as per specification using fitting tools, Safety precautions	**8**	**20**
3	**Tin Smithy:** Demonstration of various tin smithy tools and sheet metal operations such as shearing, bending and joining, Preparation of tin smithy job, Safety precautions	**6**	**15**
4	**Carpentry:** Types, sketch, specification, material, applications and methods of using of carpentry tools-saws, planner, chisels, hammers, pallet, marking gauge, vice, try square, rule, etc, Types of woods and their applications, Types of carpentry hardwires and their uses, Demonstration of carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, etc, Preparation of wooden joints, Safety precautions.	**8**	**20%**
5	**Pipefitting:** Types, specification, material and applications of pipe fittings, Types, specifications, material, applications and demonstration of pipe fitting tools, Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling, etc, Preparation of pipe fitting jobs	**6**	**15**
6	**Metal joining:** 1Select appropriate equipment and consumables for required application, Prepare the simple jobs as per specification using proper metal joining and	**6**	**15**

	cutting method, Safety precautions		

References Books:

1. Work shop technology by Hajra Chaudhary
2. Work shop technology by Chapmen

Course Outcome:

After learning the course, the students should be able to

CO1 To acquire skills in basic engineering practice

CO2 To acquire practical skills in the trades

CO3 Understand modern manufacturing operations, including their capabilities, limitations, and how to design economically.

CO4 Welding and soldering operations

CO5 Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	-	2	2	2	2	2	2	-	2
CO-2	3	2	3	-	2	2	3	-	3	3	2	-
CO-3	3	-	-	-	3	2	2	-	2	2	-	-
CO-4	3	2	2	1	2	-	3	2	-	1	-	-
CO-5	3	3	3	2	2	1	2	1	-	-	-	-

FEB120001: ENGINEERING MATHEMATICS - II

Objective: Mathematics is a language of Science and Engineering

Credit:5 **Semester IIL-T-P:3-2-0**

Sr.	Content	Total Hrs	% Weightage
1	Vector Fields, Vector derivatives, Arc length, Curvature and Torsion, Gradient of Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	09	25%
2	Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier Integral transform, Fourier Cosine Integral and Fourier Sine Integral	10	25%
3	First order ordinary differential equations, Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	06	10%
4	Ordinary differential equations of higher orders, Second order linear homogeneous differential equations with variable coefficients, Cauchy-Euler equation, Existence and Uniqueness of solution, Linear Dependence and Independence of solution, Wronskian, Non homogeneous Ordinary differential equations, method of undetermined coefficient, method of variation of parameters	11	25%
5	Series solution of Ordinary differential equations, Power series solutions; Legendre's equation, Legendre polynomials, Frobenius method, Bessel functions of the first kind and their properties	09	15%

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
3. Dennis G. Zill, 4th edition, Advanced Engineering Mathematics, 4th Edition, Jones and Bartlett Publishers.
4. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.

Course Outcome:

After learning the course the students should be able to

CO-1: To apply mathematical tools needed in evaluating vector calculus and their usage like Work, Circulation and Flux

CO-2: To apply the laplace transform as tools which are used to solve differential equations and fourier integral representation

CO-3: To apply effective mathematical tools for the solutions of first order ordinary differential equations

CO-4: To apply effective mathematical methods for the solutions of higher order ordinary differential equations

CO-5: To implement the solution for engineering problem

CO-6: To use series solution methods and special functions like Bessels'functions

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	2	1	3	-	2	3	2	2	2	2
CO-2	3	2	-	-	3	1	-	3	1	-	1	1
CO-3	3	2	2	3	3	2	2	1	3	2	-	3
CO-4	3	-	1	2	2	3	1	3	-	2	-	3
CO-5	3	3	-	1	1	3	3	-	2	-	2	2
CO-6	3	1	3	-	-	1	1	3	1	3	2	3

FEB120302: BASIC ELECTRONICS

Objective: To provide the needful inputs to handle simple electronic components and circuits. Students after studying this course will be able to understand the basics of analog electronics, various electronics components and develop skills to use simple electronic instruments needed.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs
1	**Circuit Concepts:** Electrical Quantities and Electrical Elements, Lumped Circuit and distributed circuit Elements**,** Kirchhoff's Laws**,** Meters and Measurements**,** Analogy between Electrical and other Non-Electrical Physical Systems**,** A case study.	**6**
2	**Circuit Analysis Techniques:** Thevenin and Norton Equivalent Circuits, Reciprocity and Maximum Power Transfer Theorem, Node-Voltage and Mesh-Current Analysis, Superposition and Linearity, Star to Delta and Delta to Star Transformation, Computer Aided Circuit Analysis, A Case Study.	**8**
3	**Analog Building Blocks and Operational Amplifiers Basic ideas:** The Amplifier Block, Ideal Operational Amplifier block diagram and its characteristics, Parameters of Operational Amplifiers, Applications of Operational Amplifiers, A case study.	**8**
4	**Digital Building Blocks:** Digital System Building Blocks, Digital System Components, Computer Systems, Computer Networks, A case study	**8**
5	**Signal Processing:** Signals and Spectral Analysis ,Modulation, Sampling and Multiplexing, Interference and Noise, A case Study	**8**
6	**Communication Systems**: Waves, Transmission Lines, waveguides and Antenna, Fundamentals Analog Communication Systems, Digital Communication Systems, Optical Communication Systems, Satellite Communication Systems, Wireless Communication Systems ,A Case Study	**6**
7	**Basic Control Systems:** Feedback Control Systems, Digital Control Systems, A Case Study	**6**

Reference Books:

1. Introduction to Electrical Engineering, M S Sarma, Oxford University Press

Course Outcome:

After completion of the course, the student will be able to –

CO-1 : Determine the behavior of simple passive electrical circuits with independent voltage andcurrent. Sources.

CO-2 : Design simple analog signal processing functions using operational amplifiers.

CO-3 : Design simple combinational and sequential functions using gates and flip-flops.

CO- 4 : Explain the functioning of digital system components including DACs, ADCs, memory and display devices,

CO-5 : Explain the organization of computer systems and computer networks.

CO-6: Determine the properties of simple signal processing systems.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**2**	**2**	**2**	**-**	**2**	**3**	**2**	**2**	**2**	**3**	**1**	**1**
CO-2	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**
CO-3	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**-**
CO-4	**3**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO-5	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO-6	**-**	**2**	**2**	**2**	**2**		**-**	**1**	**-**	**2**	**3**	**-**

FEB120403: COMPUTER PROGRAMMING WITH C

Objective: An introduction to computer concepts, logic, and computer programming.

Credit:5 **L-T-P:4-0-2**

Unit	Description in detail	Hours	Weightage
I	**Introduction to Computer and Programming:** Introduction, Architecture and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high level programming, Algorithms, Flowchart, Programming Languages, Types of Languages **C Fundamentals:** Features of C Language, Basic Structure of C Program, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Declaration of Storage Classes ,Operators and Expressions, Managing Input and Output Operations	**10**	**20%**
II	**Control Structure in C:** Simple if Statement nested if, if-else, Nesting of if Else, The Else if Ladder, switch-case, Looping constructs: for, while, do-while, Nesting Looping , break and continue, goto statement. **Arrays and String:** One-dimensional arrays, Multi-dimensional arrays, String variables, Arithmetic Operations on Characters, Comparison of Strings, Table of Strings, String Storage, Built-in-string functions	**10**	**23%**
III	**Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing **Recursion:** Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort , Merge sort.	**9**	**22%**
IV	**Pointers:** Introduction, Understanding of pointers, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointers, Pointers expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and Character Strings, Pointers on pointers, Pointer as function argument, Functions returning pointer, Pointers to functions, Pointers and structures.	**8**	**19%**

	Dynamic Memory Allocation: Introduction to Dynamic memory allocation, malloc, calloc and realloc		
V	**Structure and Unions:** Introduction, Structures definition, Giving values to members, Structure initialization, Comparison of structure variables, Arrays of structures, Arrays within structure, Structure and function, Unions, Size of structures, Bit fields. **File Management:** Introduction, Defining and opening a file, Closing a file, Input/output operations on files, Error handling during I/O operations, Random access to files, Command line arguments.	**8**	**16%**

Reference Books:

1. Programming in ANSI C by Balagurusamy, 7th Ed., Tata McGraw Hill
2. Programming with C, Second edition, by Gottfried, Tata McGraw-Hill Publishing
3. Company Limited.
4. Let Us C by YashvantKanetkar, 12th Ed., BPB Publication
5. Programming in C by Ashok N. Kamthane, 2nd Ed., Pearson Education
6. Let us C, Yashavant P. Kanetkar, BBP Publications, Delhi
7. "Computer programming", Pearson Education, 2007 by Ashok N. Kamthane.
8. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing.

Course Outcome:

After learning the course the students should be able to:

CO-1: Understand the fundamentals and structure of a C programming language

CO-2: Apply the loops, arrays, functions and string concepts in C to solve the given problem

CO-3: Apply the pointers and text input output files concept to find the solution for the given applications.

CO-4: Use the Enumerated, Data types, Structures and Unions

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	-	-	-	-	-	-	-	-	-	-	-
CO-2	-	3	1	-	-	-	-	-	-	-	-	-
CO-3	-	3	1	-	-	-	-	-	-	-	-	-
CO-4	1	3	-	-	-	-	-	-	-	-	-	-

FEB120204: ENGINEERING GRAPHICS

Objective: Engineering Graphics is the language of communication for Engineers. Engineering Graphics course provides tools and techniques of communication for various fields of Engineering.

Credit:5 **L-T-P:3-0-4**

Sr.	Content	Total Hrs	% Weightage
1	**INTRODUCTION TO ENGINEERING GRAPHICS**: Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS-SP-46, Representative Fraction, Types of Scales (Plainand Diagonal Scale), Dimensioning Terms and Notations, Types of Arrowheads, Lines, Lettering, Numbering and Dimensioning.	**03**	**5%**
2	**ENGINEERING CURVES**: Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutes and Cycloids with Tangents and Normal.	**06**	**10%**
3	**PROJECTIONS OF POINTS AND STRAIGHT LINES**:- Introduction to principal planes of projections, Notation System- Points in First, Second, Third and Fourth quadrants, Projections of line Parallel to Two and Perpendicular to one of the principal planes, Line parallel to one and inclined to two principal planes, Line inclined to all the three principal planes, True length of the line and its inclination with the reference planes	**08**	**15%**
4	**PROJECTIONS OF PLANES**: Projections of various planes -Polygonal, Circular and Elliptical shape inclined to one of the Reference Plane and inclined to two Reference Planes; Concept of Auxiliary Plane of Projections.	**06**	**10%**

5	**PROJECTIONS OF SOLIDS AND SECTIONS OF SOLIDS**: Classifications of Solids, Projections of right and regular solids with their axis Parallel to Two and Perpendicular to one of the principal planes, axis parallel to one and inclined to two principal planes, axis inclined to all the three principal planes. Section of solids and the true shape of the section	**08**	**15%**
6	**DEVELOPMENT OF SURFACES**: Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	**08**	**15%**
7	**ORTHOGRAPHIC PROJECTIONS**: Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection method; Full Sectional Orthographic Views -Side and Front, Offset Cutting views.		**15%**
8	**ISOMETRIC VIEW/DRAWING AND ISOMETRIC PROJECTIONS**: Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing		**15%**

References Books:-

1. ENGINEERING GRAPHICS, P. J. Shah; S. Chand & Co., New Delhi Publications.
2. Engineering Drawing N.D. Bhatt & V.M. Panchal; Charotar Publishing House
3. Engineering Graphics – I and II ByArunoday Kumar Tech – Max Publication, Pune
4. A text book of Engineering Drawing By R.K.Dhawan, S.Chand& Company Ltd., New Delhi.
5. A text book of Engineering Drawing By P.S.Gill, S. K. Kataria & sons, Delhi.

Course Outcome:-

After Learning the course the students shall be able to:

CO1 To know and understand the conventions and the method of engineering drawing.
CO2 Identify the Drawing Symbols, Conventions used in Engineering Drawing
CO3 Construct the Different types of Engineering Curves.

CO4 To improve their visualization skills so that they can apply these skill in developing new products.

CO5 Apply Descriptive Geometry Principles to Solve Engineering Problems Involving Points, Lines, Planes and Solids

CO6 To improve their technical communication skill in the form of communicative drawings

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	-	2	2	2	2	2	2	-	2
CO-2	3	2	3	-	2	2	3	-	3	2	2	-
CO-3	3	-	-	-	3	2	2	-	2	2	-	-
CO-4	3	3	3	1	2	-	2	2	-	1	-	-
CO-5	3	3	3	2	2	1	2	1	-	-	-	-
CO-6	3	2	3	2	2	1	2	1	1	1	-	-

FEB120105: ENVIRONMENTAL SCIENCE

Objective: To inculcate the environmental values translating into pro-conservation actions. Honourable Supreme Court of India has made it 'mandatory' to introduce a basic course on environment at the undergraduate level.

Credit:0 **L-T-P:2-2-0**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Environment:** Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System	**02**	**07%**
2	**Ecology and Ecosystems:** Introduction: Ecology- Objectives and Classification , Concept of an ecosystem- structure and functions of ecosystem Components of ecosystem- Producers, Consumers, Decomposers Bio-Geo- Chemical Cycles- Hydrologic Cycle, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs ,Ecological Pyramids **Natural Resources:** a. Renewable and Nonrenewable resources, exploitation and conservation, Role of individual in conservation of natural resources.	**04**	**14%**

3	**ENVIRONMENTAL POLLUTION:** a) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of Water pollutants, Effects of water pollutants b) Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO 2 ,NO X , Auto exhaust, Effects of common air pollutants c) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects d) Solid Waste: Generation and management e) Bio-medical Waste: Generation and management f) E-waste: Generation and management	**12**	**41%**
4	**GLOBAL ENVIRONMENTAL ISSUES:** Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change	**05**	**17%**
5	**BASIC CONCEPT OF GREEN BUILDING AND SMART CITIES** Green Building: Introduction, Objectives, Fundamental Principles, Benefits of Green Building, Examples of Green Building Smart Cities: Concept	**04**	**14%**
6	**CONCEPT OF 4R's** Principles, Application of 4R's	**02**	**7%**

References Books:-

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha Second edition, 2013 Publisher: Universities Press (India) Private Ltd, Hyderabad.
2. Basics of Environmental Studies by Prof Dr N S Varandani, 2013 Publisher: LAP –Lambert Academic Publishing, Germany
3. Environmental Studies by Anindita Basak, 2009 Publisher: DrlingKindersley(India)Pvt. Ltd Pearson

4. Textbook of Environmental Studies by Deeksha Dave & S SKateva , Cengage Publishers.
5. Environmental Sciences by Daniel B Botkin & Edward A Keller Publisher: John Wiley & Sons.
6. Environmental Studies by R. Rajagopalan, Oxford University Press
7. Environmental Studies by Benny Joseph, TMH publishers
8. Environmental Studies by Dr. Suresh K Dhameja, 2007 Published by: S K Kataria & Sons New Delhi
9. Basics of Environmental Studies by U K Khare, 2011 Published by Tata McGraw Hill

Course Outcome:-

After learning the course the students should be able to:

CO-1 : Students are able to learn types of disasters and its profile in India..

CO-2 : Students are able to understand the causes and impacts of disasters on environment and related case studies of Global and National disasters.

CO-3 : Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters..

CO- 4 : To understand the concept of Disaster Management Cycle and its Risk Reduction Measures

CO-5 : Students to learn the National Acts and policies for mitigating disasters, Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management..

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**3**	**3**	**2**	**-**	**2**	**3**	**2**	**2**	**2**	**3**	**1**	**1**
CO-2	**3**	**1**	**2**	**3**	**-**	**2**	**2**	**1**	**2**	**2**	**-**	**-**
CO-3	**2**	**-**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**-**	**2**	**2**
CO-4	**2**	**2**	**2**	**2**	**1**	**-**	**1**	**2**	**2**	**1**	**1**	**2**
CO-5	**2**	**2**	**1**	**2**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**-**

FEB130001: EFFECTIVE TECHNICAL COMMUNICATION

Objective: To help students learn technical communication along with necessary moral and ethical dimensions of engineering.

Credit:5 **Semester IIIL-T-P:2-0-2**

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Dynamics of Communication:** Definition and process, Kinesics, Proxemics, Paralinguistic features, Importance of Interpersonal and Intercultural Communication in today's organizations	**06**	20%
2.	**Technical Writing:** Report writing, Technical proposal, Technical description, Business letters(sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter), Agenda of meeting, Minutes of meeting , Resume writing	**08**	**25%**
3.	**Technical Communication**: Public speaking, Group discussion , Presentation strategies, Interview skills, Negotiation skills, Critical and Creative thinking in communication	**06**	**20%**
4.	**Ethics in Engineering:** Scope of engineering ethics, Accepting and sharing responsibility, Responsible professionals and ethical corporations, Resolving ethical dilemmas, Making moral choices.	**04**	**12%**
5.	**Etiquettes:** Telephone etiquettes, Etiquettes for foreign business trips, Visits of foreign counterparts, Etiquettes for small talks, Respecting privacy Learning to say NO, Time management	**05**	**16%**
6	**Self-development and Assessment:** Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream.	**03**	**7%**

Reference Book :

1. Raman and Sharma, Technical Communications, OUP, New Delhi, 2017

2. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018
3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014
4. Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance, Pearson, UP, 2013
5. Ramesh and Ramesh, The Ace of Soft Skills, Pearson, UP, 2019
6. Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009

Course Outcome:

After learning the course the students should be able to:

CO-1: Define and discuss dynamics of Verbal and Non-Verbal aspects of Communication.

CO-2: Write various formal documents of technical and professional communication.

CO-3: Communicate in diverse formal situations taking place in organizations.

CO-4: Illustrate and examine the knowledge of ethical aspects of engineering.

CO-5: Demonstrate and explain social and professional etiquettes.

CO-6: Plan self-development and practice self-assessment.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	-	-	-	2	-	-	-	2	2	3	-	3
CO-2	-	-	-	2	-	1	-	1	-	3	1	3
CO-3	-	-	-	-	-	1	-	1	1	3	1	3
CO-4	-	-	-	-	-	1	1	3	2	3	1	3
CO-5	-	-	-	-	-	1	1	1	1	3	1	2
CO-6	-	1	1	1	-	1	-	-	2	3	-	3

FEB130002: INDIAN CONSTITUTION

Objective: To help students learn Indian Constitution along with necessary moral and ethical dimensions.

Credit:0 **L-T-P:2-0-0**

Sr No.	Subject Content	Teaching Hours
1.	Meaning of the constitution law and constitutionalism	1
2.	History of Indian Constitution	2
3.	Salient features and characteristics of the Constitution of India	1
4.	Fundamental rights	2
5.	Right to Equality under Article – 14	2
6	Right to certain Freedom under Article 19	2
7	Scope of the Right to Life and Personal Liberty under Article 21	2
8	Fundamental Duties and its legal status	2
9	The Directive Principles of State Policy – Its importance and implementation	2
10	Federal structure and distribution of legislative and financial powers between the Union and the States	3
11	Parliamentary Form of Government in India – The constitution powers and status of the President of India	2
12	Powers and Procedure for Amendments in Indian Constitution	1
13	History of amendments in Indian Constitutional	2
14	Emergency Provisions: National Emergency, President Rule, Financial Emergency	3
15	Local Self Government – Constitutional Scheme in India	3

Reference Books:

1. Constitutional Law of India, Dr. J.N. Pandey, Central Law Agency
2. Introduction to the Consitution of India, Durga Das Basu, LexisNexis.
3. Indian Constitutional Law, M.P. Jain, LexisNexis
4. V.N.Shukla's Constitution of India, Mahndra Pal Singh, Eastern Book Company
5. Constitutional Law – I Structure, Udai Raj Rai, Eastern Book Company

Course Outcome:

CO-1 : Explain the background of the present constitution of India and features...

CO-2 : Utilize the fundamental rights and duties..

CO-3 : Understand the working of the union executive, parliament and judiciary

CO- 4 : Understand the working of the state executive, legislature and judiciary.

CO-5 : Utilize the special provisions and statutory institutions..

CO-6 : Show national and patriotic spirit as responsible citizens of the country

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**1**	**1**
CO-2	**2**	**2**	**3**	**3**	**-**	**2**	**2**	**1**	**2**	**2**	**-**	**-**
CO-3	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**2**
CO-4	**3**	**2**	**2**	**2**	**1**	**-**	**1**	**2**	**2**	**1**	**1**	**2**
CO-5	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**-**
CO-6	**2**	**2**	**2**	**2**	**2**		**2**	**1**	**1**	**2**	**3**	**-**

FEB130401: ENGINEERING MATHEMATICS-III

Objective: Systematic study of uncertainty by probability-statistics and curve fitting by numerical methods.

Credit:4 **L-T-P:3-0-2**

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Basic Probability:** Experiment, definition of probability, conditional probability, independent events, Bayes' rule, Bernoulli trials, Random variables, discrete random variable, probability mass function, continuous random variable, probability density function, cumulative distribution function, properties of cumulative distribution function, Two dimensional random variables and their distribution functions, Marginal probability function, Independent random variables.	**08**	**20%**
2.	**Some special Probability Distributions**: Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Normal, Exponential and Gamma densities, Evaluation of statistical parameters for these distributions.	**10**	**22%**
3.	**Basic Statistics:** Measure of central tendency: Moments, Expectation, dispersion, skewness, kurtosis, expected value of two dimensional random variable, Linear Correlation, correlation coefficient, rank correlation coefficient, Regression, Bounds on probability, Chebyshev‘s Inequality.	**10**	**22%**
4.	**Applied Statistics:** Formation of Hypothesis, Test of significance: Large sample test for single proportion, Difference of proportions, Single mean, Difference of means, and Difference of standard deviations. Test of significance for Small samples: t- Test for single mean, difference of means, t-test for correlation coefficients, F- test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	**10**	**22%**
5.	**Curve fitting by the Numerical Method:** Curve fitting by of method of least squares, fitting of straight lines,	**04**	**14%**

	second degree parabola and more general curves.		

Reference Books:

1. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
4. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
5. J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.

Course Outcome:

After learning the course the students should be able to:

CO-1: understand the terminologies of basic probability, two types of random variables and their probability functions

CO-2: observe and analyze the behavior of various discrete and continuous probability distributions

CO-3: understand the central tendency, correlation and correlation coefficient and also regression

CO-4: apply the statistics for testing the significance of the given large and small sample data by using t- test, F- test and Chi-square test

CO-5: understand the fitting of various curves by method of least square

CO-6: understand the central tendency methods and apply it in computer problems

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)											
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	2	2	2	-	2	2	-	1
CO-2	3	2	2	1	2	2	2	-	2	1	-	-
CO-3	3	2	-	1	1	-	2	-	2	-	-	-
CO-4	3	2	-	1	1	-	3	-	2	1	-	-
CO-5	3	2	2	1	1	-	2	-	2	-	-	-
CO-6	3	3	1	1	1	-	2	-	2	2	-	-

FEB130402: DIGITAL ELECTRONICS

Objective: The objective of this course is to provide the fundamental concepts associated with the digital logic and circuit design. To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits. To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems. The course will help in design and analysis of the digital circuit and system.

Credit:5L-T-P:3-0-2

Unit	Description in detail	Hours	Weightage
I	**Binary System:** Digital computer and digital systems, Binary Number, Number base conversion Octal and Hexadecimal Number, complements, Binary Codes, Binary Storage and register, Binary Logic, Integrated Circuit **Boolean Algebra and Mapping Methods:** Boolean Algebra, Karnaugh Maps, Variable Entered Maps, Realizing Logic Function with Gates, Combinational Design Examples.	**10**	**20%**
II	**Logic Function Realization with MSI Circuits:** Combinational Logic with Multiplexers and Decoders, Standard Logic Functions with MSI Circuits, Design Problem Using MSI Circuits. **Flip Flops, Counters and Registers:** Flip Flops and its Applications	**14**	**30%**
III	**Registers Transfer Logic & Micro-Operation :** Introduction, Inter-register Transfer, Arithmetic, logic and shift Micro-Operations, Conditional Control Statements, Fixed-Point Binary Data, overflow, Arithmetic Shifts, Decimal Data, Floating-Point Data, Instruction Codes, Design of Simple Computer **Logic Families:** Transistor-Transistor Logic(TTL), Emitter-Coupled Logic(ECL), MOSFET Logic, TTL Gates.	**8**	**10%**
IV	**Synchronous State Machine Design:** Sequential Counters, State Changes Referenced to Clock, Number of State Flip-Flops, Input Forming Logic, Output Forming Logic, Generation of a State Diagram from a Timing Chart, Redundant States, General State Machine	**15**	**30%**

	Architecture **Asynchronous State Machines:** The Fundamental-Mode Model, Problems of Asynchronous Circuits Basic Design Principles, An Asynchronous DesignExample.		
V	**Programmable Logic Devices:** Introduction to Programmable Logic Devices, Read-Only Memory, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL), Combinational PLD-Based State Machines, State Machines on a Chip	**5**	**10%**

Reference Books :

1. Digital Logic & State Machine Design By David J. Comer, Third Indian Edition, Oxford University Press.
2. Digital Logic and Computer Design By M Morris Mano, Fourth Edition, Prentice Hall Publication.
3. Digital Principles and Applications ByMalvino& Leach, Seventh Edition, McGraw-Hill Education.
4. Modern Digital Electronics By R.P.Jain, Fourth Edition, Tata McGraw-Hill Education.
5. Digital Electronics: Principles and Integrated Circuits By A.K. Maini, Wiley India Publications.
6. Digital Design M. Morris Mano and Michael D. Ciletti, Pearson Education.
7. Digital Electronics and Design with With VHDL, Volnei A. Pedroni, Elsevier (Morgan Kaufmann Publishers).

After completion of the course, the students will be able to:

CO-1: Explain about digital number systems and logic circuits

CO-2: The student should be able to solve logic function minimization

CO-3: The students should be able to differentiate between combinational and sequential circuits such as decoders, encoders, multiplexers, demultiplexers, flip-flops, counters, registers.

CO-4: They should be able to design using FSM

CO-5: They should be able to start writing HDL codes for various digital circuits

CO-6: At the end they should be able to develop a course project using digital integrated circuits

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	-	3	1	-	-	-	-	2	3
CO-2	2	-	2	-	3	-	-	2	-	2	1	-
CO-3	2	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	1	-	1	-	2	1	-	-	2	1	1
CO-5	2	1	-	1	2	-	1	-	1	-	1	-
CO-6	1	1	2	-	1	2	1	1	1	2	1	-

FEB130403: OBJECT ORIENTED PROGRAMMING WITH C++

Objective: The main aim of OOP is to bind together the data and the functions that operate on them so that no other part of the code can access this data except that function.

Credit:5 **L-T-P:3-0-4**

Unit	Description in detail	Hours	Weightage
I	**Concepts of OOP :** Introduction OOP, Procedural Vs. Object Oriented Programming, Principles of OOP, Benefits and applications of OOP **C++ Basics :** Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures	**10**	**18%**
II	**C++ Functions :** Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments, friend functions, virtual functions **Objects and Classes :** Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion	**14**	**27%**
III	**Inheritance :** Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class **Polymorphism :**Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism	**14**	**25%**
IV	**I/O and File Management :** Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream, C++ File stream classes, File management functions, File modes, Binary and random Files	**8**	**15%**
V	**Templates, Exceptions and STL:** What is template? function templates and class templates, Introduction to exception, try-catch-throw, multiple catch, catch all, rethrowing exception, implementinguser defined exceptions, Overview and use of Standard Template Library	**8**	**15%**

Reference Books :

1. Object Oriented Programming With C++, E Balagurusamy, TMH

2. C++ Programming, Black Book, Steven Holzner, dreamtech
3. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia
4. Object Oriented Programming with ANSI and Turbo C++, Ashok Kamthane, Pearson
5. The Compete Reference C++, Herbert Schlitz, TMH
6. C++ and Object Oriented Programming Paradigm, PHI
7. C++: How to Program, 9th Edition, Deitel and Deitel, PHI
8. Object Oriented Programming with C++, Saurav Sahay, Oxford

CO-1: Learn the basics of learning problems with hypothesis and version spaces
CO-2: Write the skeleton of C++ program
CO-3: Write the simple C++ programs using the variables, operators, control structures, functions and I/O, objects, cin and cout.
CO-4: Use features of C++ like type conversion, inheritance, polymorphism, I/O streams and files to develop programs for real life problems.
CO-5: Use advance features like temples and exception to make programs supporting reusability and sophistication.
CO-6: Use standard template library for faster development.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	-	3	1	-	-	-	-	2	3
CO-2	2	-	2	-	3	-	-	2	-	2	1	-
CO-3	2	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	1	-	1	-	2	1	-	-	2	1	1
CO-5	2	1	-	1	2	-	1	-	1	-	1	-
CO-6	1	1	2	-	1	2	1	1	1	2	1	-

FEB130404: DATA STRUCTURE & ALGORITHMS

Objective: Understanding of data structures is essential and this facilitates the understanding of the language. The practice and assimilation of data structure techniques is essential for programming. The knowledge of C language and data structures will be reinforced by practical exercises during the course of study. The course will help students to develop the capability of selecting a particular data structure.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Basic Concepts of Data Structures:** Data Structure Basic Concepts and Types of data structures, Primitive and non primitive data structures, Introduction to Algorithms and Key features of an algorithm, Analysis Terms (for the definitions purpose only) : a. Time Complexity b. Space Complexity c. Asymptotic Notations ,Big 'O',Notation , Best case Time Complexity, Average case Time Complexity, Worst case Time Complexity, and Types of Data Structures- Linear &Non Linear Data Structures.	**04**	10%
2	**Linear Data Structure:** Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, Tower of Hanoi Queue: Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue Linked List: Singly Linked List, Doubly Linked List,Circular linked List, Linked implementation of Stack, Linked implementation of Queue, Applications of Linked	**13**	30%

	List.		
3	**Nonlinear Data Structure :** Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees- Some balanced tree mechanism, eg. AVL trees, 2-3 trees, Height Balanced, Weight Balance, Graph-Matrix Representation Of Graphs, Elementary Graph operations,(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)	**13**	30%
4	**Hashing And File Structures :** Hashing: Hash functions : Division Method, Middle Square Method, Folding Method The symbol table, Collision-Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, hashing for direct files, Multi-Key file organization and access methods.	**06**	15%
5	**Sorting And Searching:** Sorting Methods – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search and Binary Search	**06**	15%

Reference Books:

1. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G.Sorenson Publisher-Tata McGraw Hill.
2. Data Structures using C & C++ -By Ten Baum Publisher – Prenctice-Hall International.
3. Fundamentals of Computer Algorithms by Horowitz, Sahni,Galgotia Pub. 2001 ed.
4. Fundamentals of Data Structures in C++-By Sartaj Sahani.
5. Data Structures: A Pseudo-code approach with C -By Gilberg&Forouzan Publisher-Thomson Learning.

CO-1: Define data structures like array, stack, queues and linked list.

CO-2: Explain insertion, deletion and traversing operations on data structures.

CO-3: Identify the asymptotic notations to find the complexity of an algorithm.

CO-4: Compare various searching and sorting techniques.

CO-5: Choose appropriate data structure while designing the algorithms.

CO-6: Design advance data structures using nonlinear data structures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	-	-	-	-	-	-	-	-	-	-	-
CO-3	3	2	2	2	-	-	-	-	-	-	-	-
CO-4	3	2	2	2	-	-	-	-	-	-	-	-
CO-5	3	3	3	2	-	-	-	-	-	-	-	-
CO-6	3	3	2	2	-	-	-	-	-	-	-	-

FEB140001: ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Objective: Essence of Indian Knowledge Tradition will focus on Indian philosophical, linguistic and artistic traditions, along with yoga and Indian perspective of modern scientific worldview. The curriculum has been reworked to meet the "industry demands".

Credit:0 **Semester IV** **L-T-P:3-0-0**

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	Basic Structure of Indian Knowledge System (i) वेद, (ii) उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्वेद, स्थापत्य आदि) (iii) वेदांग (शिक्षा, कल्प, निरुत, व्याकरण, ज्योतिष छंद), (iv) उपाइग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)	24	60
2.	Modern Science and Indian Knowledge System.	06	15
3.	Yoga and Holistic Health care	06	15
4.	Case Studies	04	10

References Books:-

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritz of Capra, Tao of Physics
4. Fritz of Capra, The wave of Life
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta
7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, VidyanidhiPrakasham, Delhi, 2016
8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, VidyanidhiPrakasham, Delhi, 2016
9. P R Sharma (English translation), ShodashangHridayam

Course Outcome:-

CO-1: Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective

CO-2: Identify the concept of Traditional knowledge and its importance.

CO 3: Explain the need and importance of protecting traditional knowledge.

CO 4: Illustrate the various enactments related to the protection of traditional knowledge.

CO 5: Interpret the concepts of Intellectual property to protect the traditional knowledge.

CO 6: Explain the importance of Traditional knowledge in Agriculture and Medicine.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	-	-	2	3	2	2	2	3	1	1
CO-2	2	2	2	1	2	-	-	1	-	2	-	-
CO-3	2	3	-	1	1	-	2	-	-	2	-	-
CO-4	3	3	3	1	1	2	2	-	-	-	-	-
CO-5	2	2	2	2	2	-	-	-	-	2	-	-
CO-6	-	3	2	2	2	3	-	1	-	2	3	-

FEB140401: DISCRETE MATHEMATICS

Objective: Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following: Use mathematically correct terminology and notation., Construct correct direct and indirect proofs, Use division into cases in a proof.

Credit:4 **L-T-P:3-2-0**

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Sets, Relation and Function:** Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.	**08**	16%
2.	**Principles of Mathematical Induction**: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.	**10**	18%
3.	Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.	**10**	18%
4.	**Propositional Logic:** Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques:** Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	**10**	18%
5.	**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and	**04**	14%

	Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form		
6.	**Graphs and Trees:** Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.	**06**	16%

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, WadsworthPublishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
4. Discrete Mathematics, Tata McGraw – Hill
5. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and its Application to Computer Science", TMG Edition, TataMcgraw-Hill.

Course Outcome:

After learning the course the students should be able to:

CO-1: Understand the basic principles of sets and operations in sets and apply counting principles to determine probabilities, domain and range of a function, identify one-to- one functions, perform the composition of functions and apply the properties of functions to application problems.

CO-2: Write an argument using logical notation and determine if the argument is or is not valid. To simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contra positives using truth tables and the properties of logic. To express a logic sentence in terms of predicates, quantifiers, and logical connectives.

CO-3: Apply relations and to determine their properties. Be familiar with recurrence relations

CO-4: Use the properties of algebraic structures.

CO-5: Interpret different traversal methods for trees and graphs. Model problems in Computer Science using graphs and trees.

CO-6: understand the central tendency methods and apply it in computer problems

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	1	1	2	2	2	-	2	2	-	1
CO-2	3	2	2	1	2	2	2	-	2	1	-	-
CO-3	3	2	2	1	1	-	2	-	2	-	-	-
CO-4	3	2	2	1	1	-	2	-	2	1	-	-
CO-5	3	2	2	1	1	-	2	-	2	-	-	-
CO-6	3	2	1	1	1	-	2	-	2	2	-	-

FEB140402: COMPUTER ORGANIZATION

Objective: Measurement and Metrology deals with the application of science in Mechanical Engineering. It provides a means of assessing the suitability of measuring instruments, their calibration, and the quality control of manufactured products.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Computer Data Representation** Basic computer data types, Complements, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Register Transfer language, Register Transfer, Bus and Memory Transfers (Tree-State Bus Buffers, Memory Transfer), Arithmetic Micro-Operations, Logic Micro Operations, Shift Micro-Operations, Arithmetic logical shift unit	**6**	10%
2	Basic Computer Organization and Design Instruction codes, Computer registers, computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Inputoutput and interrupt, Complete computer description, Design of Basic computer, design of Accumulator Unit.	**4**	10%
3	Programming The Basic Computer Introduction, Machine Language, Assembly Language, assembler, Program loops, Programming Arithmetic and logic operations, subroutines, I-O Programming.	**4**	10%
4	Micro programmed Control: Control Memory, Address sequencing, Micro program Example, design of control Unit	**3**	5%
5	Central Processing Unit Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC)	**4**	15%

6	Pipeline And Vector Processing Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction, Pipeline, RISC Pipeline, Vector Processing, Array Processors	**3**	10%
7	Computer Arithmetic Introduction, Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Decimal Arithmetic Unit	**4**	10%
8	Input-Output Organization Input-Output Interface, Asynchronous Data Transfer, Modes Of Transfer, Priority Interrupt, DMA, Input-Output Processor (IOP), CPUIOP Communication, Serial communication.	**4**	10%
9	Memory Organization Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.	**2**	10%
10	Multipreocessors Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Inter-processor Communication and Synchronization, Cache Coherence, Shared Memory Multiprocessors	**4**	10%

Reference Books:

1. M. Morris Mano, Computer System Architecture, Pearson
2. Andrew S. Tanenbaum and Todd Austin, Structured Computer Organization, Sixth Edition, PHI
3. M. Murdocca& V. Heuring, Computer Architecture & Organization, WILEY
4. John Hayes, Computer Architecture and Organization, McGrawHill

After completion of the course, the students will be able to:

CO-1: Identify, understand and apply different number systems and codes.(Understanding)

CO-2: Identify, compare and assess to Bus and memory (Applying, Analyzing)

CO-3: Identify and analyze basic organization of CPU (Analyzing)

CO-4: Identify and learn the concept of memory hierarchy

CO-5: Analyze and learn peripheral devices (Analyzing, Designing)

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	2	1	1	-	1	1	-	-	-	-	-
CO-2	-	1	3	-	1	-	1	-	-	-	-	-
CO-3	1	3	-	1	1	-	-	-	-	-	-	-
CO-4	2	-	1	-	-	-	1	-	-	-	-	-
CO-5	-	2	1	-	1	1	-	-	-	-	-	-

FEB140403: OPERATING SYSTEM

Objective: To provide users a convenient interface to use the computer system. To act as an intermediary between the hardware and its users, making it easier for the users to access and use other resources. To manage the resources of a computer system.

Credit:4 **L-T-P:3-0-2**

Unit	Description in detail	Hours	Weightage
I	Introduction, Process Management Processes: Basics of Operating Systems: Definition – Generations of Operating systems – Types of Operating Systems, OS Service, System Calls, OS structure: Layered, Monolithic, Microkernel Operating Systems – Concept of Virtual Machine, Definition , Process Relationship, Process states , Process State transitions , Process Control Block ,Context switching – Threads – Concept of multithreads , Benefits of threads – Types of threads Process Scheduling: Definition , Scheduling objectives ,Types of Schedulers ,Scheduling criteria : CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only) , Scheduling algorithms : Pre emptive and Non , pre emptive , FCFS – SJF – RR , Multiprocessor scheduling : Types , Performance evaluation of the scheduling.	**13**	**25**
II	Interprocess Communication, Deadlocks : Race Conditions, Critical Section, Mutual Exclusion, Hardware Solution, Strict Alternation , Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc., Scheduling , Scheduling Algorithms, Definition,Deadlock characteristics , Deadlock Prevention , Deadlock Avoidance :banker's algorithm, Deadlock detection and Recovery.	**10**	**21**
III	Memory Management **:** Definition ,Logical and Physical address map , Memory allocation : Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction , Paging : Principle of operation – Page allocation – Hardware support for paging –,Protection and sharing –	**8**	**15**

	Disadvantages of paging, Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging (Concepts only) – Page Replacement policies : Optimal (OPT) , First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)		
IV	I/O Management Principles of I/O Hardware, File Management:I/O devices, Device controllers , Direct memory access Principles of I/O Software: Goals of Interrupt handlers , Device drivers , Device independent I/O software , Secondary-Storage Structure: Disk structure ,Disk scheduling algorithm, File concept, A access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table),efficiency & performance	**10**	**22**
V	Security & Protection, Unix/Linux Operating System **:**Security Environment, Design Principles Of Security, User Authentication, Protection Mechanism : Protection Domain, Access Control List, Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration Case study: Linux, Windows Operating System.	**7**	**17**

Reference Books :

1. Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley Indian Edition (2010).
2. Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008).
3. Principles of Operating Systems by Naresh chauhan, Oxford Press (2014).
4. Operating Systems by D.M. Dhamdhere, Tata McGraw Hill 2nd edition.
5. Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000
6. UNIX Concepts and Applications(4 th Edition)– by Sumitabha Das, Tata McGraw Hill.
7. Unix Shell Programming – by Yashwant Kanetkar, BPB publications.

After completion of the course, the students will be able to:

CO-1: Students will describe basic concepts of Operating System

CO-2: Describe the important computer system resources and the role of operating system in their management policies and algorithms

CO-3: Understand the process management policies and scheduling of processes by CPU

CO-4: Evaluate the requirement for process synchronization and coordination handled by operating system

CO-5: Describe and analyze the memory management and its allocation policies.

CO-6: Identify use and evaluate the storage management policies with respect to different storage management technologies

CO-7: Identify the need to create the special purpose operating system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	-	3	1	-	-	-	-	2	3
CO-2	2	-	2	-	3	-	-	2	-	2	1	-
CO-3	2	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	1	-	1	-	2	1	-	-	2	1	1
CO-5	2	1	-	1	2	-	1	-	1	-	1	-
CO-6	1	1	2	-	1	2	1	1	1	2	1	-
CO-7	3	-	-	1	2	-	1	-	2	2	-	3

FEB140404: DESIGN & ANALYSIS OF ALGORITHMS

Objective: Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand and analyse efficient algorithms for various applications.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Basics of Algorithms andAnalysis of Algorithm:** What is an algorithm?, Mathematics for Algorithmic Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations.The efficient algorithm, Average, Best and worst case analysis, Amortized analysis , Asymptotic Notations, Analyzing control statement, Loop invariant and the correctness of the algorithm, Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Shell sort Heap sort, Sorting in linear time : Bucket sort, Radix sort and Counting sort	**10**	12%
2	**Divide and Conquer Algorithm:** Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers Problem, Problem Solving using divide and conquer algorithm - Binary Search, Max-Min problem, Matrix Multiplication, Exponential.	**06**	15%
3	**Dynamic Programming:** Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating the Binomial Coefficient, Matrix chain multiplication, Making Change Problem, All Points Shortest path, Assembly Line-Scheduling, Knapsack problem, Longest Common Subsequence.	**05**	20%
4	**Greedy Algorithm:** General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees graphs: Shortest paths,	**05**	20%

	The Knapsack Problem, Job Scheduling Problem, Huffman code.		
5	**Exploring Graphs:** An introduction using graphs and games, Undirected Graph, Directed Graph, Traversing Graphs, Depth First Search, Breath First Search, Topological sort, Connected components ,Backtracking and Branch and Bound: Introduction, The Eight queens problem , Knapsack problem, Travelling Salesman problem, Minimax principle	**07**	15%
6	**String Matching:** Introduction, The naive string matching algorithm, The Rabin-Karp algorithm, String Matching with finite automata, The Knuth-Morris-Pratt algorithm.	**03**	8%
7	**Introduction to NP-Completeness:** The class P and NP, Polynomial reduction, NP- Completeness Problem, NP-Hard Problems. Travelling Salesman problem, Hamiltonian problem, Approximation algorithms	**05**	10%

Reference Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.
2. Fundamental of Algorithms by Gills Brassard, Paul Bratley, PHI.
3. Foundations of Algorithms, Shailesh R Sathe, Penram
4. Design and Analysis of Algorithms, Dave and Dave, Pearson.
5. Introduction to Design and Analysis of Algorithms, Anany Levitin, Pearson.

After completion of the course, the students will be able to:

CO-1: Analyse the asymptotic performance of algorithms.
CO-2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms

CO-3: Find optimal solution by applying various methods.

CO-4: Apply pattern matching algorithms to find particular pattern.
CO-5: Differentiate polynomial and non-polynomial problems.

CO-6: Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	-	-	-	-	-	-	-	1	2	-
CO-2	-	2	1	-	-	-	-	-	-	1	2	-
CO-3	-	3	-	-	-	-	-	-	-	-	2	-
CO-4	-	2	1	-	-	-	-	-	2	-	1	-
CO-5	1	2	-	-	-	-	-	-	-	1	2	-
CO-6	2	2	1	-	-	-	-	-	-	-	2	-

FEB140405: DATABASE MANAGEMENT SYSTEM

Objective: The DBMS manages the data; the database engine allows data to be accessed, locked and modified; and the database schema defines the database's logical structure. These three foundational elements help provide concurrency, security, data integrity and uniform data administration procedures.

Credit:4 **L-T-P:3-0-2**

Unit	Description in detail	Hours	Weightage
I	Introductory concepts of DBMS : Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture-levels, Mappings, Database, users and DBA	**02**	**5%**
II	Relational Model : Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus Entity-Relationship Model : Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets, extended E-R features – generalization, specialization, aggregation, reduction to E-R database schema	**07**	**20%**
III	Relational Database Design : Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1Nf, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multi- valued dependency, 4NF, Join dependency and 5NF Query Processing & Query Optimization : Overview, measures of query cost, selection operation, sorting, join, evaluation of expressions, transformation of relational expressions, estimating statistics of expression results, evaluation plans, materialized views	**09**	**25%**
IV	Transaction Management : Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism,	**11**	**25%**

	solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking Security: Introduction, Discretionary access control, Mandatory Access Control, Data Encryption		
V	SQL Concepts : Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. transaction control commands – Commit, Rollback, Savepoint PL/SQL Concepts : Cursors, Stored Procedures, Stored Function, Database, Triggers	**13**	**25%**

Reference Books :

1. An introduction to Database Systems, C J Date, Addition-Wesley.
2. Database System Concepts, Abraham Silberschatz, Henry F. Korth & S. Sudarshan, McGraw Hill.
3. Understanding SQL by Martin Gruber, BPB
4. SQL- PL/SQL by Ivan bayross
5. Oracle – The complete reference – TMH /oracle press
6. Database Systems Concepts, design and Applications 2/e,Singh, S. K. PearsonEducation, New Delhi, 2011
7. SQL/ PL/SQL Bayross, Ivan BPB, New Delhi, 2010.
8. Introduction to Database Systems ITL ESL.Pearson Education, New Delhi, 2010
9. An Introduction to Database Systems Date, C. J. PearsonEducation, New Delhi,2006
10. Database System Concepts, Korth, Henry McGrawHill, Delhi, 2011

After completion of the course, the students will be able to:

CO-1: Students will be able to know the need of Program Data Independence and DBMS technology as a backend database development in Application Software.

CO-2: Students will be able to apply E-R Modelling to prepare E-R diagrams for database design. Formulate relational tables from E-R diagram and Relational modelling, populate relational database and formulate SQL queries on data.

CO-3: Students will be able to identify the Functional Dependency in data and eliminate it with Normalization to improve database design.

CO-4: Students will be able to learn Concurrency Control mechanism, Database Recovery methods with Transaction Theory.

CO-5: Students will be able to apply the knowledge, techniques, models and modern tools to become successful database professionals in software industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	3	3	-	2	-	-	-	2	-	-	-
CO-3	1	2	-	-	-	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	-	-	-	-	-
CO-6	-	-	-	-	-	3	-	-	-	-	-	-

FEB150001: ENGINEERING ECONOMICS AND MANAGEMENT

Objective: This course introduces the basic concepts of management and organization structure of an industry, concept of Entrepreneurship, Material management cost analysis, engineering economics and project management.

Credit:3 **Semester V** **L-T-P:3-0-0**

Unit	Description in detail	Hours	Weightage
I	**Introduction to Economics**; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; meaning, determinants, law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity **Theory of production;** production function, meaning, factors of production (meaning & characteristics of Land, Labor, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical	**8**	**20%**
II	**Markets;** meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income. **Basic economic problems;** Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control	**9**	**20%**
III	**Money;** meaning, functions, types, Monetary policy-meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR. **Introduction to Management;** Definitions, Nature, scope Management & administration, skill, types and roles of	**8**	**21%**

	managers Management Principles; Scientific principles, administrative principles, Maslow's Hierarchy of needs theory		
IV	**Functions of Management;** Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization. **Introduction to Marketing management;** Marketing Mix, concepts of marketing, demand forecasting and methods, market segmentation Introduction to Finance Management; meaning, scope, sources, functions	**10**	**22%**
V	**Introduction to Production Management;** definitions, objectives, functions, plant layout-types & factors affecting it, plant location- factors affecting it. Introduction to Human Resource Management; definitions, objectives of manpower planning, process, sources of recruitment, process of selection Corporate Social Responsibility; meaning, importance Business Ethics; meaning, importance	**7**	**17%**

Reference Books :

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
3. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
4. Principles and Practices of Management by L.M.Prasad
5. Principles of Management by Tripathy and Reddy
6. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

CO-1: Understand different components of system software

CO-2: Understand intermediate code generation in context of language designing

CO-3: Recognize operating system functions such as memory management as pertaining to run time storage management.

CO-4: To understand and implement Assembler, Loader, Linkers, Macros & Compilers

CO-5: To introduce students the process management and information management via different software tools

CO-6: To introduce student the fundamental model of the processing of high-level language programs for execution on computer system.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	3	2	1	3	-	2	2	2	1
CO-2	3	3	2	1	2	-	-	-	-	-	-	-
CO-3	2	2	3	2	3	1	-	-	2	-	-	-
CO-4	3	3	2	2	1	-	2	2	-	2	1	1
CO-5	2	2	2	1	2	-	-	-	-	2	-	-
CO-6	3	3	2	2	2	-	1	1	-	1	2	-

FEB150401: SYSTEM PROGRAMMING

Objective: As a core subject of Computer Engineering/Information Technology, this course enables to understand importance of System Programming, its functionalities.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	Weightage
1.	**Introduction to System Programming**: Software, Software Hierarchy, Systems Programming, Machine Structure, Interfaces, Address Space, Computer Languages,Tools, Life Cycle of a Source Program, Different Views on the Meaning of a Program, System Software Development, Recent Trends in Software Development, Levels of System Software	03	10%
2.	**Language Processors:** Programming Languages and Language Processors, LanguageProcessing Activities, Program Execution, FundamentalofLanguageProcessing(phases and passes of compiler and role of each analyzer), Fundamental of Language Specification,Symbol Table Data Structures for Language Processing: Search Data structures, Allocation Data Structures.	05	12%
3.	**Scanning and Parsing:** Regular Grammars and Regular Expression, Finite state automata, Building DFAs, The Scanning Process, An Elementary Scanner Design and Its Implementation, The role of a parser, Top down parsing-naïve approach, Recursive descent parser, LL (1) parser, Bottom up parsingnaïve approach, simple precedence grammars, Operator Precedence Parsing	07	15%
4.	**Assemblers**: Elements of Assembly Language Programming, Design of the Assembler, Assembler Design Criteria, Types of Assemblers, Two-Pass Assemblers, One-Pass Assemblers, Single pass Assembler for Intel x86 , Algorithm of Single Pass Assembler, Multi-Pass Assemblers, Advanced Assembly Process, Variants of	07	15%

	Assemblers Design of two passassembler,		
5.	**Macro Processors:** Macro Definition and Call, Macro Expansion, Nested Macro Calls, Advanced Macro Facilities, Design Of Macro Preprocessor, Design of macro assembler	**06**	**15%**
6.	**Linker Loader:** Introduction, Relocation of Linking Concept, Design of a Linker, Self-Relocating Programs, Linking in MSDOS, Linking of Overlay Structured Programs, Dynamic Linking, Loaders, Different Loading Schemes, Sequential and Direct Loaders, Compile-and-Go Loaders, General Loader Schemes, Absolute Loaders, Relocating Loaders, Practical Relocating Loaders, Linking Loaders, Relocating Linking Loaders, Linkers v/s Loaders	**07**	**15%**
7.	**Compiler:** Aspects of Compilation, Memory Allocation, Compilation of Expression and Control Structure, Code Optimization, Interpreter	**03**	**10%**
8.	**Interpreters &Debuggers :** Benefits of Interpretation, Overview of Interpretation, The Java Language Environment, Java Virtual Machine, Types of Errors, Debugging Procedures, Classification of Debuggers, Dynamic/Interactive Debugger	**03**	**8%**

Reference Book

1. System Programming by D M Dhamdhere McGraw Hill Publication
2. System Programming by Srimanta Pal OXFORD Publication
3. System Programming and Compiler Construction by R.K. Maurya& A. Godbole.
4. System Software – An Introduction to Systems Programming by Leland L. Beck, 3rd Edition, Pearson Education Asia, 2000
5. System Software by SantanuChattopadhyay, Prentice-Hall India,2007

After completion of the course, the students will be able to:

CO-1: Understand different components of system software

CO-2: Understand intermediate code generation in context of language designing

CO-3: Recognize operating system functions such as memory management as pertaining to run time storage management.

CO-4: To understand and implement Assembler, Loader, Linkers, Macros & Compilers

CO-5: To introduce students the process management and information management via different software tools

CO-6: To introduce student the fundamental model of the processing of high-level language programs for execution on computer system.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	3	2	1	3	-	2	2	2	1
CO-2	3	2	2	1	2	-	-	-	-	-	-	-
CO-3	3	2	3	2	3	1	-	-	2	-	-	-
CO-4	3	3	2	2	1	-	2	-	-	-	1	1
CO-5	3	2	2	1	2	-	-	-	-	-	-	-
CO-6	3	3	2	2	2	-	1	1	-	1	2	-

FEB150402: OBJECT ORIENTED PROGRAMMING WITH JAVA

Objective: Object oriented Programming has become a fundamental part of software development. OOP facilitates Reuse of code, flexibility, effective problem solving. It provides a modular structure for programs and implementation details are hidden. Reuse of code lowers the cost of development.

Credit:5 **L-T-P:3-0-4**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to java and elementary programming:** Java language specification API, JDK and IDE, Creating, compiling and Executing a simple java program, Programming style, documentation and errors, Reading input from console, identifiers and variables, Assignment statements, Named constants and naming conventions, Data Types (Numeric, Boolean, Character, String) its Operations and Literals, Evaluating Expressions and operator Precedence, Types of Operators (Augmented assignment, Increment and Decrement, Logical), operator precedence and associativity, numeric typeconversions.	03	07%
2	**Selections , Mathematical functions and loops:** If statements, Two way, Nested if and multi-way if statements, Switchstatements,ConditionalExpressions,Commonmathematical Functions,While, do-while and for loop, nested loops, Keyword break and continue.	03	07%
3	**Methods and Arrays:** Defining and calling method, Passing argument by values, Overloading methods and scope of variables, Method abstraction and stepwise refinement, Single Dimensional arrays, copying arrays,Passing and returning array from method, Searching and sorting arrays and the Array class, Two-Dimensional array and its processing, Passing Two-dimensional Array to methods, MultidimensionalArrays.	06	12%

4	**Objects and Classes:** Defining classes for objects, Constructors, accessing objects via reference variable, using classes from the java library, static variables, constants and methods, visibility modifiersand Data field encapsulation, passing objects to methods, array of objects, immutable objects and classes, scope of variable and the this reference.	**03**	**10%**
5	**Object oriented thinking:** Class abstraction and Encapsulation, thinking in objects and class relationships, Primitive data type and wrapper class types, Big integer and Big decimal class, string class, StringBuilder and String Buffer class, Inheritance, using super keyword, overriding and overloading methods, polymorphism and dynamic binding, casting objects and Instance of operator, The ArrayListclassand its methods, The protected data and methods.	**07**	**15%**
6	**Exception Handling, I/O, abstract classes and interfaces:** Exception types, finally clause, rethrowing Exceptions, chained exceptions, defining custom exception classes, file class and its input and output, Reading data from web, Abstract classes, interfaces,Comparable and Cloneabal interface.	**05**	**10%**
7	**Concurrency** Thread states and life cycle, Creating and Executing threads with the Executor Framework, Thread synchronization	**02**	**05%**
8	**Binary I/O ,Recursion and Generics:** Text I/O, binary I/O, Binary I/O classes, Object I/o, Random Access files, Problem solving using Recursion, Recursive Helper methods, Tail Recursion, Defining Generic classes andInterfaces, Generic methods, Raw types and backward compatibility, wildcard Generic types, Erasure and Restrictions on Generics.	**04**	**12%**
9	**List, Stacks, Queues and Priority Queues:** Collection, Iterators, Lists, The Comparator interface, static methods for list and collections, Vector and Stack classes, Queues and priority Queues.	**03**	**7%**

10	**JAVAFX basics and Event-driven programming and animations:** Basic structure of JAVAFX program, Panes, UI control and shapes, Property binding, the Color and the Font class, the Image and Image-View class, layout panes and shapes,Events and Events sources, Registering Handlers and Handling Events, Inner classes, anonymous inner class handlers, mouse and key events, listeners for observable objects,animation. JAVAFX UI controls and multimedia: Labeled and Label, button, Checkbox, RadioButton, Textfield, TextArea, Combo Box, ListView, Scrollbar, Slider, Video and Audio.	**07**	**15%**

Reference Books:

1. Intro to Java Programming, 10th edition,Y.vLiang,Pearson
2. Java Fundamentals A comprehensive introduction By Herbert Schildt, Dale Skrien, McGraw HillEducation
3. Object oriented programming with Java ,RajkumarBuyya,SThamaraiSelvi, Xingchen Chu,McGrawHill
4. Programming in Java, Sachin Malhotra, SaurabhChoudhary,Oxford
5. Programming with JAVA , E Balagurusamy,McGrawHill
6. CORE JAVA volume -I Cay Horstmann,Pearson
7. The Complete Reference, Java 2 (Fourth Edition),HerbertSchild, -TMH.

After completion of the course, the students will be able to:

CO-1: Use various Java constructs, features and libraries for simple problems.
CO-2: Demonstrate how to define and use classes, inheritance, interfaces, create objects and methods, how to override and overload methods, compile and execute programs

CO-3: Write a program using exception handling, multithreading with synchronization.

CO-4: Write a program using Files, binary I/O, collection Frameworks for a give no problem

CO-5: Design and develop GUI based applications in a group using modern tools and frameworks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	-	2	-	2	-	-	-	2	-	-
CO-2	2	2	2	-	3	2	-	-	-	1	-	-
CO-3	-	1	-	2	-	2	-	-	-	-	-	-
CO-4	1	3	2	1	-	-	-	-	-	-	-	-
CO-5	-	2	1	2	-	-	-	-	-	-	-	-

FEB150403: MICRO PROCESSOR & INTERFACING

Objective: The modern digital systems including computer systems are designed with microprocessor as central device connected to memory and I/O devices. The subject introduces the students with basics of microprocessor, microprocessor architecture and programming, interfacing microprocessor with memory and various I/O (Input/output) devices and introduction to the advance processors including RISC based processors.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Microprocessor, Components of a Microprocessor:** Registers, ALU and control & timing, System bus (data, address and controlbus), Microprocessor systems with bus organization, Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O Operations	03	09%
2	**8085 Microprocessor Architecture**: Address, Data And Control Buses, 8085Pin Functions, Demultiplexing of Buses, Generation Of Control Signals,Instruction Cycle, Machine Cycles, T-States, Memory Interfacing, Classification of Instructions,Addressing Modes, 8085 Instruction Set, Instruction And Data Formats,Writing, Assembling & Executing A Program, Debugging The Programs	04	12%
3	**Stack & Subroutines** Developing Counters and Time Delay Routines, CodeConversion, BCD Arithmetic and 16-Bit Data operations,Interfacing Concepts, Ports, Interfacing Of I/O Devices, Interrupts In 8085,Programmable Interrupt Controller 8259A, Programmable PeripheralInterface 8255A	05	15%
4	**Evolution of microprocessors**:	10	20%

	8086 Microprocessor -Architecture and signals, Memory organization,Minimum and maximum mode of operation, Minimum mode Timing Diagram. Comparison of 8086and 8088.8086 Addressing Modes, 8086 Instruction set andAssembler Directives - Assembly LanguageProgramming with Subroutines, Macros, PassingParameters, Use of stack.		
5	**Interrupts**: Types of Interrupts and Interrupt ServiceRoutine. Handling Interrupts in 8086, Interruptprogramming. Basic Peripherals and their Interfacingwith 8086 - Programmable Interrupt Controller - 8259 -Architecture.	**04**	**12%**
6	**Interfacing Memory**: I/O, 8255 - Detailed study -Architecture, Control word format and modes ofoperation, Architecture and modes of operation of8279 and 8257 (Just mention the control word, no need to memorize the control word format)	**04**	**12%**
7	**Microcontrollers** Types of Microcontrollers – Criteriafor selecting a microcontroller - Example Applications.Characteristics and Resources of a microcontroller.Organization and design of these resources in a typicalmicrocontroller - 8051. 8051 Architecture, Register Organization, Memory andI/O addressing, Interrupts and Stack. 8051 Addressing Modes, Different types ofinstructions and Instruction Set, Simple programs.Peripheral Chips for timing control - 8254/8253.	**10**	**20%**

Reference Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh S. Gaonkar Pub: Penram International.
2. Advanced Microprocessors, Daniel Tabak, McGrawHill
3. The 8088 and 8086 Microprocessors, Triebel& Singh, Pearson Education
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education.
5. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill.

After completion of the course, the students will be able to:

CO-1: List and specify the various features of microprocessor, memory and I/O devices including concepts of system bus

CO-2: Identify the various elements of 8085 microprocessor architecture, its bus organization including control signals

CO-3: List the pin functions of the 8085 microprocessor

CO-4: Describe different modes of operations of a typical microprocessor and microcontroller.

CO-5: Interface microprocessors with various external devices

CO-6: Analyze and compare the features of microprocessors and microcontrollers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	-	-	3	3	2	3	1	1	1	1
CO-2	2	2	2	1	2	-	-	-	-	-	-	-
CO-3	3	1	-	1	1	-	-	-	1	-	-	-
CO-4	2	-	3	-	1	-	3	-	-	-	-	-
CO-5	3	2	2	-	2	-	-	-	1	1	-	-
CO-6	2	-	3	2	3	-	-	-	-	3	1	-

FEB150404: WEB TECHNOLOGY

Objective: Subject covers the wide range of web technologies both client side and server side to provide the exposure to the students to develop Rich Internet Applications using them. It covers the basics WWW, client side technologies like HTML, CSS and DHTML including JavaScript, server side scripting with PHP and database connectivity using PHP and related technologies.

Credit:5 **L-T-P:3-0-4**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction** : Concept of WWW, Internet and WWW, HTTP Protocol : Request and Response, Web browser and Web servers, Features of Web 2.0	03	7%
2	**Web Design**: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation	03	8%
3	**HTML** : Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Characterentities,framesandframesets,BrowserarchitectureandWebsite structure. Overview and features of HTML5	10	20%
4	**Style Sheets** : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3	03	10%
5	**JavaScript**:ClientsidescriptingwithJavaScript,variables,functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascriptand objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS	10	20%

	and Javascript, Events and buttons		
6	**XML** : Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT	**03**	**10%**
7	**PHP** : Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP	**08**	**15%**
8	**PHP and MySQL** : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs	**03**	**10%**

Reference Books:

1.Developing Web Applications, Ralph Moseley and M. T. Savaliya,Wiley-India
2.Web Technologies, Black Book, dreamtechPress
3.HTML 5, Black Book, dreamtechPress
4.Web Design, Joel Sklar, CengageLearning
5.Developing Web Applications in PHP and AJAX, Harwani,McGrawHill
6.Internet and World Wide Web How to program, P.J. Deitel& H.M. Deitel,Pearson

After completion of the course, the students will be able to:

CO-1: Understanding the Principles of Object-Oriented Programming

CO-2: Students should gain proficiency in the Java programming language, including its syntax, data types, control structures, and object-oriented features.

CO-3: Designing and Implementing Classes &Applying Object-Oriented Analysis and Design (OOAD) Principles

CO-4: Designing and Implementing Classes, Encapsulation and Information Hiding, Inheritance and Polymorphism, Exception Handling

CO-5: Students should understand software development principles such as modularity, reusability, and maintainability, and apply them in their Java programming projects

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	2	1	-	-	2	2	3	2
CO-2	3	2	2	2	1	1	-	-	3	2	3	2
CO-3	3	3	3	2	2	2	-	-	3	1	2	2
CO-4	3	2	3	2	2	1	-	-	2	2	2	3
CO-5	3	2	2	2	2	2	-	-	2	1	3	2

FEB160402: THEORY OF COMPUTATION

Objective: You will broaden your knowledge of the fundamental mathematical and computational principles that are the foundation of computer science, To understand the concept of Deterministic Finite Automata and Non-Deterministic Finite Automata, To understand how to minimize the states, usage Moore and Mealy Machine, To understand how to use the context free grammars in languages and how to derive parse trees and solve ambiguity problems.

Credit:3 **Semester VI** **L-T-P:3-0-0**

Sr.	Content	Total Hrs	% Weightage
1	**Review of Mathematical Theory:** Sets, Functions, Logical statements, Proofs, relations, languages, Mathematical induction, strong principle, Recursive definitions	06	16%
2	**Regular Languages and Finite Automata:** Regular expressions, regular languages, applications, Automata with output-Moore machine, Mealy machine, Finite automata, memory requirement in a recognizer, definition, union, intersection and complement of regular languages. NonDeterminism Finite Automata, Conversion from NFA to FA, □- Non Determinism Finite Automata Conversion of NFA- □ to NFA and equivalence of three Kleene's Theorem, Minimization of Finite automata Regular And Non Regular Languages – pumping lemma.	08	20%
3	**Context free grammar (CFG):** Definition, Unions Concatenations And Kleen's of Context free language Regular grammar, Derivations and Languages, Relationship between derivation and derivation trees, Ambiguity Unambiguous CFG and Algebraic Expressions BacosNaur Form	08	20%

	(BNF), Normal Form – CNF		
4	**Pushdown Automata, CFL And NCFL:** Definition, deterministic PDA, Equivalence of CFG and PDA, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL	**08**	**20%**
5	**Turing Machine (TM):** TM Definition, Model Of Computation And Church Turning Thesis, computing functions with TM, Combining TM, Variations Of TM, Non Deterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy **Computable Functions:** Partial, total, constant functions, Primitive Recursive Functions, Bounded Mineralization, Regular function, Recursive Functions	**10**	**24%**

Reference Books:

1. Introduction to Languages and the Theory of Computation by John C. Martin, McGraw-Hill, Inc.

2. Theory of Computation by S.N. Sivanandam& M. Janaki Meena, I. K. International Publishing House Pvt. Ltd.

3. An introduction to automata theory and formal languages by Adesh K. Pandey, Publisher: S.K. Kataria& Sons

4. Introduction to computer theory by Deniel I. Cohen , Joh Wiley & Sons, Inc

5. Computation: Finite and Infinite by Marvin L. Minsky Prentice-Hall

6. Compiler Design by Alfred V Aho, Addison Weslley

7. Introduction to the Theory of Computation by Michael Sipser

8. Automata Theory, Languages, and Computation by John Hopcroft, Rajeev Motowani, and Jeffrey Ullman

After completion of the course, the students will be able to:

CO-1: At the end of the course the students will be able to understand the basic concepts and application of Theory of Computation

CO-2: Students will apply this basic knowledge of Theory of Computation in the computer field to solve computational problems and in the field of compiler also.

CO-3: Will apply knowledge of computing and mathematics appropriate to the discipline

CO-4: Learn about Turing Machines and Pushdown Automata and understand Linear Bound Automata and its applications

CO-5: Solve computational problems regarding their computability and complexity and prove the basic results of the theory of computation

CO-6: Will apply knowledge of computing and mathematics appropriate to the discipline

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	3	-	1	-	-	-	-	2	2
CO-2	2	2	2	3	2	-	-	2	-	1	1	-
CO-3	3	2	1	2	1	-	-	1	-	-	2	2
CO-4	2	2	2	1	-	2	1	-	-	1	1	1
CO-5	2	2	2	1	2	-	1	-	1	-	1	-
CO-6	2	3	2	2	1	2	1	1	1	1	1	1

FEB160402: COMPUTER NETWORKS

Objective: Build an understanding of the fundamental concepts of computer networking, Familiarize the student with the basic taxonomy and terminology of the computer networking area, Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking, Independently understand basic computer network technology.

Credit:5 **L-T-P:4-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Computer Networks and Internet;** Understanding of network and Internet, The network edge, The network core, Understanding of Delay, Loss and Throughput in the packet switching network, protocols layers and their service model, History of the computer network The Physical layer: Bandwidth, Maximum data rate of a signal, Guided and unguided transmission media.	07	17%
2	**The Link layer and Local area networks:** Introduction and link layer services, error-detection and correction techniques, Multiple access protocols, addressing, Ethernet, switches.	06	15%
3	**Network Layer:** Introduction, Virtual and Datagram networks, study of router, IP protocol and addressing in the Internet, Routing algorithms, Broadcast and Multicast routing	10	25%
4	**Transport Layer:** Introduction and transport layer services, Multiplexing and Demultiplexing, Connection less transport (UDP), Principles of reliable data transfer, Connection oriented transport (TCP), Congestion control.	10	25%
5	**Application Layer:** Principles of computer applications, Web and HTTP, E-mail, DNS, Socket programming with TCP and UDP	07	18%

Reference Books:

1. Computer Networking- A Top-Down approach, 5th edition, Kurose and Ross, Pearson
2. Computer Networks- A Top-Down approach, BehrouzForouzan, McGraw Hill
3. Computer Networks (4th edition), Andrew Tanenbaum, Prentice Hall
4. Computer Networking and the Internet (5th edition),Fred Halsall, Addison Wesley
5. Data Communications and Networking (4th edition), BehrouzForouzan, McGraw Hill
6. TCP/IP Protocol Suite (3rd edition), BehrouzForouzan, McGraw Hill

After completion of the course, the students will be able to:

CO-1: Analyze the requirements for a given organizational structure and select the most appropriate Networking architecture and technologies;

CO-2: specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;

CO-3: Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

CO-4: Have a working knowledge of datagram and internet socket programming

CO-5: Implement any topology using network devices & Network Performance and Optimization

CO-6: Network Security, Services and Applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	2	3	1	2	1	2	2	2	3
CO-2	3	2	2	2	3	2	2	2	3	2	1	2
CO-3	3	2	1	2	1	2	2	1	2	1	2	1
CO-4	3	3	2	2	2	2	1	1	2	2	1	1
CO-5	3	2	2	1	2	2	1	1	1	2	1	2
CO-6	3	2	3	1	1	2	1	1	1	2	1	1

FEB160403: SOFTWARE ENGINEERING

Objective: A program or set of programs containing instructions that offer desired functionality is referred to as software. And engineering is the process of creating and building anything that serves a certain function and solves issues in a cost-effective manner. Software engineering is the systematic, disciplined, quantitative study and approach to designing, developing, operating, and maintaining a software system.

Credit:4 **L-T-P:3-0-2**

Unit	Description in detail	Hours	Weightage
I	Introduction to Software and Software Engineering ,Agile Development **:** The Evolving Role of Software, Software: A Crisis on the Horizon and Software Myths, Software Engineering: A Layered Technology, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models, Agile Process Model, Component-Based Development, Process, Product and Process. Agility and Agile Process model, Extreme Programming, Other process models of Agile Development and Tools	**9**	**20%**
II	Managing Software Project ,Requirement Analysis and Specification**:** Software Metrics (Process, Product and Project Metrics), Software Project Estimations, Software Project Planning (MS Project Tool), Project Scheduling & Tracking, Risk Analysis &Management (Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation).Understanding the Requirement, Requirement Modeling, Requirement Specification (SRS), Requirement Analysis and Requirement Elicitation, Requirement Engineering.	**7**	**20%**
III	Software Design ,Software Coding & Testing **:**Design Concepts and Design Principal, Architectural Design, Component Level Design (Function Oriented Design, Object Oriented Design) (MS Visio Tool),User Interface Design, Web Application Design.Coding Standard and coding Guidelines, Code Review, Software Documentation, Testing Strategies, Testing Techniques and Test Case, Test Suites Design, Testing Conventional	**9**	**25%**

	Applications, Testing Object Oriented Applications, Testing Web and Mobile Applications, Testing Tools (Win runner, Load runner		
IV	Quality Assurance and Management , Software Maintenance and Configuration Management : Quality Concepts and Software Quality Assurance, Software Reviews (Formal Technical Reviews), Software Reliability, The Quality Standards: ISO 9000, CMM, Six Sigma for SE, SQA Plan.Types of Software Maintenance, Re-Engineering, Reverse Engineering, Forward Engineering, The SCM Process, Identification of Objects in the Software Configuration, Version Control and Change Control	**8**	**% 20**
V	Software Engineering and Software as a Service Advanced Topics in Software Engineering**:**Product Lifetime: Independent Product Vs. Continues, Improvement, Software as a Service, SaaS ArchitectureComponent-Based Software Engineering, Client/Server Software Engineering, Web Engineering, Reengineering, Computer-Aided Software Engineering, Software Process Improvement, Emerging Trends in software Engineering.	**6**	**15%**

Reference Books :

1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill International Editions
2. Ian Sommerville, Software engineering, Pearson education Asia
3. Pankaj Jalote, Software Engineering – A Precise Approach Wiley
4. Software Engineering Fundamentals by Ali Behhforoz& Frederick Hudson OXFORD
5. Rajib Mall, Fundamentals of software Engineering, Prentice Hall of India.
6. Engineering Software as a Service An Agile Software Approach, Armando Fox and David Patterson
7. John M Nicolas, Project Management for Business, Engineering and Technology, Elsevier

After completion of the course, the students will be able to:

CO-1: Prepare SRS (Software Requirement Specification) document and SPMP (Software Project Management Plan) document

CO-2: Apply the concept of Functional Oriented and Object Oriented Approach for Software Design

CO-3: Recognize how to ensure the quality of software product, different quality standards and software review techniques

CO-4: Apply various testing techniques and test plan in.

CO-5: Able to understand modern Agile Development and Service Oriented Architecture Concept of Industry

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	-	-	-	3	3	2	3	2	2	1	1
CO-2	3	2	2	1	2	-	-	-	-	-	-	-
CO-3	3	2	2	1	2	-	-	-	-	-	-	-
CO-4	3	2	2	1	2	-	3	-	-	-	-	-
CO-5	3	2	2	1	2	-	-	-	-	-	-	-

FEB160404: ADVANCE JAVA

Objective: The course covers Graphical User Interface (GUI) networking, and database manipulation. Student will be able to use advanced technology in Java such as Internationalization, and Remote method Invocation. Student will learn how to work with JavaBeans.

Credit:4 **L-T-P:3-0-2**

Unit	Description in detail	Hours	Weightage
I	**Java Networking&JDBC Programming:** Network Basics and Socket overview, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URL, URLConnection, The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, Updating Database Data, Error Checking and the SQLException Class, The SQLWarning Class, The Statement Interface, PreparedStatement, CallableStatement The ResultSet Interface, Updatable Result Sets, JDBC Types, Executing SQL Queries, ResultSetMetaData, Executing SQL Updates, Transaction Management.	**7**	**15%**
II	**Servlet API and Overview:** Servlet Model: Overview of Servlet, Servlet Life Cycle, HTTP Methods Structure and Deployment descriptor ServletContext and ServletConfig interface, Attributes in Servelt, Request Dispacher interface The Filter API: Filter, FilterChain, Filter Config Cookies and Session Management: Understanding state and session, Understanding Session Timeout and Session Tracking, URL Rewriting.	**10**	**25%**
III	**Java Server Pages JSP Overview:** The Problem with Servlets, Life Cycle of JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment JSP Directives, JSP Action, JSP Implicit Objects JSP Form Processing, JSP Session and Cookies Handling, JSP Session Tracking JSP Database Access, JSP Standard Tag	**10**	**25%**

	Libraries, JSP Custom Tag, JSP Expression Language, JSP Exception Handling, JSP XML Processing.		
IV	**Java Server Faces2.0:** Introduction to JSF, JSF request processing Life cycle, JSF Expression Language, JSF Standard Component, JSF Facelets Tag, JSF Convertor Tag, JSF Validation Tag, JSF Event Handling and Database Access, JSF Libraries: PrimeFaces.	**03**	**10%**
V	**Hibernate 4.0 and Java Web Frameworks:** Overview of Hibernate, Hibernate Architecture, Hibernate Mapping Types, Hibernate O/R Mapping, Hibernate Annotation, Hibernate Query Language, Spring MVC Overview of Spring, Spring Architecture, bean life cycle, XML Configuration on Spring, Aspect – oriented Spring, Managing Database, Managing Transaction.	**11**	**25%**

Reference Books:

1. Black Book "Java server programming" J2EE, 1st ed., Dream Tech Publishers, 2008. 3. Kathy walrath "
2. Complete Reference J2EE by James Keogh mcgraw publication
3. Professional Java Server Programming by SubrahmanyamAllamaraju, Cedric Buest Wiley Publication
4. SCWCD, Matthew Scarpino, HanumantDeshmukh, JigneshMalavie, Manning publication
5. Core Java, Volume II: Advanced Features by Cay Horstmann and Gary Cornell Pearson Publication
6. Java Persistence with Hibernate by Christian Bauer, Gavin King
7. Spring in Action 3rd edition , Craig walls, Manning Publication
8. Hibernate 2nd edition, Jeff Linwood and Dave Minter, Beginning Après publication
9. Java Server Faces in Action, Kito D. Mann, Manning Publication
10. JDBC™ API Tutorial and Reference, Third Edition, Maydene Fisher, Jon Ellis, Jonathan Bruce, Addison Wesley
11. Beginning JSP, JSF andTomcat, Giulio Zambon, Apress
12. JSF2.0 CookBook, Anghel Leonard, PACKT publication

After completion of the course, the students will be able to:

CO-1: Use various tools, and Validation techniques, use of different templates available in IntelliJ IDEA, Implementation and testing strategies in real time applications.
CO-2: Use advanced concepts related to Web Services, spring and Hibernate
CO-3: Understand the concepts related to Java Technology
CO-4: Explore and understand use of Java Server Programming
CO-5: Students learn skills to develop real time applications
CO-6: At Develop advanced skills for programming in Java

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	2	3	1	2	2	3	2	2	3
CO-2	3	2	2	2	3	2	1	2	2	2	1	2
CO-3	2	2	1	2	1	1	1	1	2	2	2	2
CO-4	2	2	2	1	2	2	1	2	2	2	1	1
CO-5	2	1	2	1	2	2	1	1	1	2	1	2
CO-6	3	2	2	1	1	2	1	1	3	2	1	2

FEB160001: CYBER SECURITY

Objective: Stay up to date with the latest cyber security news and trends and make sure you are implementing adequate cyber security measures in your organization using suitable hardware and software. Avoid the risks of phishing attacks by adhering to ethical security behavior. Understanding cloud computing and how it can help your business is vital for the success of your venture.

Credit:3 **L-T-P:0-2-2**

Sr.	Content	Total Hrs	% Weightage
1	Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet	**08**	**25%**
2	Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System	**08**	**25%**
3	Web Application Tools Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra	**08**	**25%**
4	Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime,	**03**	**10%**

	Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.		
5	Introduction to Cyber Crime Investigation Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks	**05**	**15%**

Reference Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by NinaGodbole and SunitBelpure, Publication Wiley.
3. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley
4. Cyber Security and Cyber Laws Paperback – 2018 by Alfred Basta, Nadine Basta , Mary Brown , Ravinder Kumar, publication Cengage
5. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
6. Cyber security and laws – An Introduction, Madhumita Chaterjee, Sangita Chaudhary, Gaurav Sharma, Staredu Solutions

CO-1: Analyze and evaluate the cyber security needs of an organization.

CO-2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

CO-3: Measure the performance and troubleshoot cyber security systems.

CO-4: Design and develop a security architecture for an organization

CO-5: Design operational and strategic cyber security strategies and policies.

CO-6: Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)											
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	-	3	1	-	-	-	-	2	3
CO-2	2	-	2	-	3	-	-	2	-	2	1	-
CO-3	2	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	1	-	1	-	2	1	-	-	2	1	1
CO-5	2	1	-	1	2	-	1	-	1	-	1	-
CO-6	1	1	2	-	1	2	1	1	1	2	1	-

FEB160407: PROJECT - I

Objective: This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college.

Credit:3 **L-T-P:0-0-6**

CO-1 : Identify the problem by applying acquired knowledge.

CO-2 : Analyze and categorize executable project modules after considering risks.

CO-3 : Choose efficient tools for designing project modules.

CO-4 : Combine all the modules through effective team work after efficient testing.

CO-5 : Elaborate the completed task and compile the project report.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**1**	**1**
CO-2	**2**	**3**	**1**	**2**	**-**	**2**	**2**	**1**	**2**	**2**	**-**	**-**
CO-3	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**2**	**2**
CO-4	**3**	**1**	**2**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**1**	**2**
CO-5	**3**	**2**	**1**	**1**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**-**

FEB170401: COMPILER DESIGN

Objective: Compiler Design is a fundamental/core subject of Computer Engineering. It teaches how Compiler of a Programming Language works. It also focuses on various designs of Compiler and structuring and optimizing various phases of a Compiler. It is also necessary to learn types of Grammar, Finite state machines, lex, yacc and related concepts of languages.

Credit:4 **Semester VII** **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Overview of the Translation:** Process, A Simple Compiler, Difference between interpreter, assembler and compiler. Overview and use of linker and loader, types of Compiler, Analysis of the Source Program, The Phases of a Compiler, Cousins of the Compiler, The Grouping of Phases, Lexical Analysis, Hard Coding and Automatic Generation Lexical	06	15%

	Analyzers, Front-end and Back-end of compiler, pass structure		
2	**Lexical Analyzer:** Introduction to Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzers, Finite Automata From a Regular Expression, Design of a Lexical Analyzer Generator, Optimization of DFA	**06**	**15%**
3	**Parsing Theory**: Top Down and Bottom up Parsing Algorithms, Top-Down Parsing, Bottom-Up Parsing, Operator-Precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators, Automatic Generation of Parsers. Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed Definitions, L-Attributed Definitions, syntax directed definitions and translation schemes	**09**	**22%**
4	**Error Recovery:** Error Detection & Recovery, Ad-Hoc and Systematic Methods	**03**	**08%**
5	**Intermediate Code Generation**: Different Intermediate Forms, Syntax Directed Translation Mechanisms And Attributed Mechanisms And Attributed Definition.	**04**	**10%**
6	**Run Time Memory Management**: Source Language Issues, Storage Organization, Storage-Allocation Strategies, and Access to Non local Names, Parameter Passing, Symbol Tables, and Language Facilities for Dynamic Storage Allocation, Dynamic Storage Allocation Techniques.	**04**	**10%**
7	**Code Optimization**: Global Data Flow Analysis, A Few Selected Optimizations like Command Sub Expression Removal, Loop Invariant Code Motion, Strength Reduction etc.	**04**	**10%**
8	**Code Generation**: Issues in the Design of a Code Generator, The Target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, A Simple Code Generator, Register Allocation and Assignment, The DAG Representation of Basic Blocks, Peephole Optimization,	**04**	**10%**

	Generating Code from DAGs, Dynamic Programming Code-Generation Algorithm, Code Generator Generators.		

Reference Books:

1. Compilers: Principles, Techniques and Tools By Aho, Lam, Sethi, and Ullman, Second Edition,Pearson, 2014
2. Compilers: Principles, Techniques and Tools By Aho, Sethi, and Ullman, Addison-Wesley, 1986
3. Compiler Design in C By Allen I. Holub, Prentice-Hall/Pearson.
4. Advanced Compiler Design and Implementation By Muchnick, Morgan and Kaufmann, 1998.

After completion of the course, the students will be able to:

CO-1: Understand the basic concepts and application of Compiler Design

CO-2: Apply their basic knowledge Data Structure to design Symbol Table, Lexical Analyser , Intermediate

CO-3: Code Generation, Parser (Top Down and Bottom Up Design) and will able to understand strength of

CO-4: Grammar and Programming Language.

CO-5: Understand various Code optimization Techniques and Error Recovery mechanisms.

CO-6: Understand and Implement a Parser.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	-	3	1	-	-	-	-	2	3
CO-2	2	-	2	-	3	-	-	2	-	2	1	-
CO-3	2	2	1	-	1	-	-	1	-	-	2	-
CO-4	2	1	-	1	-	2	1	-	-	2	1	1
CO-5	2	1	-	1	2	-	1	-	1	-	1	-
CO-6	1	1	2	-	1	2	1	1	1	2	1	-

FEB170402: DATA MINING & BUSINESS INTELLIGENCE

Objective: Data mining has opened a world of possibilities for business. This field of computational statistics compares millions of isolated pieces of data and is used by companies to detect and predict consumer behavior. Its objective is to generate new market opportunities. Data mining converts information into knowledge.

Credit:4L-T-P:3-0-2

Unit	Description in detail	Hours	Weightage
I	**Overview and concepts Data Warehousing and Business Intelligence** Why reporting and Analysing data, Raw data to valuable information-Lifecycle of Data - What is Business Intelligence - BI and DW in today's perspective - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data 1marts - Overview of the components - Metadata in the data warehouse - Need for data warehousing - Basic elements of data warehousing - trends in data warehousing.	**04**	**10%**
II	**The Architecture of BI and DW** BI and DW architectures and its types - Relation between BI and	**11**	**25%**

	DW - OLAP (Online analytical processing) definitions - Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations **Introduction to data mining (DM)** Motivation for Data Mining - Data Mining-Definition and Functionalities – Classification of DM Systems - DM task primitives - Integration of a Data Mining system with a Database or a Data Warehouse - Issues in DM – KDD Process		
III	**Data Pre-processing** Why to pre-process data? - Data cleaning: Missing Values, Noisy Data - Data Integration and transformation - Data Reduction: Data cube aggregation, Dimensionality reduction - Data Compression - Numerosity Reduction - Data Mining Primitives - Languages and System Architectures: Task relevant data - Kind of Knowledge to be mined - Discretization and Concept Hierarchy. **Concept Description and Association Rule Mining** What is concept description? - Data Generalization and summarization-based characterization - Attribute relevance - class comparisons Association Rule Mining: Market basket analysis - basic concepts - Finding frequent item sets: Apriori algorithm - generating rules – Improved Apriori algorithm – IncrementalARM – Associative Classification – Rule Mining	**14**	**32%**
IV	**Classification and Prediction** What is classification and prediction? – Issues regarding Classification and prediction: Classification methods: Decision tree, Bayesian Classification, Rule based, CART, Neural Network Prediction methods: Linear and nonlinear regression, Logistic RegressionIntroduction of tools such as DB Miner /WEKA/DTREG DM Tools **Data Mining for Business Intelligence Applications** Data mining for business Applications like Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM etc.,Data Analytics Life Cycle: Introduction to Big data Business Analytics - State of the practice in analytics role of data scientistsKey roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.	**11**	**25%**
V	**Advance topics** Introduction and basic concepts of following topics.Clustering, Spatial mining, web mining, text mining,Big Data: Introduction to	**04**	**8%**

	big data: distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce. Introduction to Hadoop architecture: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.		

Reference Books :

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann
2. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.
3. PaulrajPonnian, "Data Warehousing Fundamentals", John Willey.
4. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education.
5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.

After completion of the course, the students will be able to:

CO-1: Inspect how data can be pre-processed before applying data mining technique
CO-2: Examine the different classification & clustering techniques in data mining
CO-3: Apply data mining techniques to solve various problems.
CO-4: Analyze and provide solutions for some problems using mining association techni
CO-5: Acquire the basic knowledge of business intelligence and data warehouse and its architecture.
CO-6: Examine the advanced data mining techniques and the popular data mining tools.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)											
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	2	3	1	-	-	-	-	-	-	-	-
CO-2	3	2	-	-	3	-	-	-	1	-	-	-
CO-3	1	-	3	-	-	-	-	1	-	-	-	2

CO-4	2	-	2	-	-	-	-	1	-	-	-	2
CO-5	2	1	-	-	-	-	-	-	-	-	-	-
CO-6	1	1	3	-	3	1	-	-	-	-	-	-

FEB170405: .NET TECHNOLOGY

Objective: It enables to fulfil varied functions like graphic rendering and file reading. It has all the resources to provide websites with different functionality and manage it smoothly at the same time. .NET provides Consistent programming model, Direct Support for Security, Simplified Development efforts and Easy application deployment and Maintenance.

Credit:4 **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to .NET Framework:** NET framework, MSIL, CLR, CLS, CTS, Namespaces, Assemblies The Common Language Implementation, Assemblies, Garbage Collection, The End to DLL Hell - Managed Execution	4	12%
2	**C# - The Basics and Console Applications in C#:**	5	14%

	Name Spaces - Constructor and Destructors, Function Overloading & Inheritance, Operator Overloading, Modifiers - Property and Indexers , Attributes & Reflection API, When to use Console Applications - Generating Console Output, Processing Console Input		
3	**C#.NET:** Language Features and Creating .NET Projects, Namespaces Classes and Inheritance -, Namespaces Classes and Inheritance -, C, Exploring the Base Class Library -, Debugging and Error Handling -, Data Types -, Exploring Assemblies and Namespaces, String Manipulation ,Files and I/O ,Collections	**4**	**10%**
4	**ADO.NET:** Benefits of ADO.NET, ADO.NET compared to classic ADO - , Datasets, Managed Providers -, Data Binding: Introducing Data Source Controls -, Reading and Write Data Using the SqlDataSource Control	**4**	**10%**
5	**Windows Forms and Controls in details:** The Windows Forms Model, Creating Windows Forms Windows Forms Properties and Events, Windows Form Controls, Menus - Dialogs – ToolTips Visual Inheritance in C#.NET: Apply Inheritance techniques to Forms, Creating Base Forms, Programming Derived Forms	**5**	**12%**
6	**Mastering Windows Forms:** Printing - Handling Multiple Events, GDI+, Creating Windows Forms Controls	**3**	**10%**
7	**ASP.NET:** Introduction to ASP.NET, Working with Web and HTML Controls, Using Rich Server Controls, Login controls, Overview of ASP.NETValidation Controls, Using the Simple Validations, Using the Complex Validators Accessing Data using ADO.NET, Using the Complex Validators Accessing	**4**	**11%**

	Data using ADO.NET, Configuration Overview		
8	**Themes and Master Pages:** Creating a Consistent Web Site, ASP.NET 2.0 Themes - Master Pages, Displaying Data with the GridView Control Introducing the GridView Control, Filter Data in the GridView Control, Allow Users to Select from a DropDownList in the Grid, Add a Hyperlink to the Grid, Deleting a Row and Handling Errors	**4**	**8%**
9	**Managing State:** Preserving State in Web Applications and Page-Level State, Using Cookies to Preserve State, ASP.NET Session State ,Storing Objects in Session State, Configuring Session State, Setting Up an Outof-Process State Server, Storing Session State in SQL Server, Using Cookieless Session IDs, Application State Using the DataList and Repeater Controls, Overview of List-Bound Controls, Creating a Repeater Control and DataList Control	**4**	**8%**
10	**Creating and Consuming Web Services:** The Motivation for XML Web Services, Creating an XML Web Service with Visual Studio, Designing XML Web Services, Creating Web Service Consumers, Discovering Web Services Using UDDI Advanced in .NET: Introduction to Windows Presentation Foundation (WPF), Window Communication Foundation and its Application	**4**	**5%**

Reference Books:

1. Christian Nagel, Professional C# .Net, Wrox Publication
2. Matthew Macdonald and Robert Standefer, ASP.NET Complete Reference, TMH
3. Vijay Mukhi, C# The Basics, BPB Publications

After completion of the course, the students will be able to:

CO-1: Understand the basic framework of .net

CO-2: Understanding and development of console applications

CO-3: Understand the basic forms and controls which is used for making windows applications.

CO-4: Understand how windows application can be used to connect database to retrieve the data

CO-5: Understand ASP.net and HTML controls
CO-6: Use ADO.NET in a web application to read, insert, and update data in a database.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	3	2	1	3	-	1	2	2	1
CO-2	3	2	2	1	2	-	-	-	-	-	-	-
CO-3	3	2	2	1	2	1	-	-	1	-	-	-
CO-4	3	2	2	2	1	-	3	-	-	-	1	1
CO-5	3	2	2	1	2	-	-	-	-	-	-	-
CO-6	3	3	2	2	2	-	1	1	-	2	3	-

FEB170408: PYTHON PROGRAMMING

Objective: Python is modern higher level programming language useful writing compact code specifically for programming in Server side, AI, Machine Learning and Deep Learning and Data Analysis.

Credit:3 **L-T-P:0-2-2**

Sr.	Content	Total Hrs	% Weightage
1	**Introduction to Python** The basic elements of python, Branching Programs, Control Structures, Strings and Input, Iteration, Functions and scoping,Specifications, Recursion, Global variables, Modules, Files System Functions and Parameters	**06**	**18%**

2	**Structured Types, Mutability and Higher-Order Functions** Strings, Tuples, Lists and Dictionaries, Lists and Mutability, Functions as Objects	**03**	**8%**
3	**Testing, Debugging, Exceptions and Assertions** Types of testing – Black-box and Glass-box, Debugging,Handling –Exceptions, Assertions	**02**	**6%**
4	**Classes and Object-Oriented Programming** Abstract Data Types and Classes, Inheritance, Encapsulation and Information Hiding	**03**	**8%**
5	**Simple Algorithms and Data structures** Search Algorithms, Sorting Algorithms, Hash Tables	**03**	**10%**
6	**Advanced Topics I** Regular Expressions – REs and Python,Plotting using PyLab Networking and Multithreaded Programming – Sockets, Threads and Processes, Chat Application	**06**	**20%**
7	**Advance Topics II** Security – Encryption and Decryption , Classical Cyphers Graphics and GUI Programming – Drawing using Turtle, Tkinter and Python, Other GUIs	**08**	**30%**

Reference Books:

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. R. Nageswara Rao, “Core Python Programming”, dreamtech.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Pyhon”, Wiley
4. Kenneth A. Lambert, “Fundamentals of Python – First Programs”, CENGAGE Publication
5. Wesley J. Chun. “Core Python Programming - Second Edition”, Prentice Hall

After completion of the course, the students will be able to:

CO-1: To develop proficiency in creating based applications using the Python Programming Language.

CO-2: To be able to understand the various data structures available in Python programming language and apply them in solving computational problems.

CO-3: To be able to do testing and debugging of code written in Python

CO-4: To be able to draw various kinds of plots using PyLab.

CO-5: To be able to do text filtering with regular expressions in Python & Data Analysis and Visualization:

CO-6: To be able to create socket applications in Python

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	3	3	1	2	3	1	2	3
CO-2	3	3	2	2	3	2	2	2	2	2	3	2
CO-3	3	2	3	3	3	2	2	1	3	2	2	2
CO-4	3	3	2	3	2	2	1	2	2	2	2	1
CO-5	3	3	2	3	2	2	1	1	2	2	2	2
CO-6	3	3	2	2	3	2	1	1	2	2	3	2

FEB170410: PROJECT - II

Objective: This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college.

Credit:6 **L-T-P:0-0-12**

CO-1 : Identify the problem by applying acquired knowledge.

CO-2 : Analyze and categorize executable project modules after considering risks.

CO-3 : Choose efficient tools for designing project modules.

CO-4 : Combine all the modules through effective team work after efficient testing.

CO-5 : Elaborate the completed task and compile the project report.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**1**	**1**
CO-2	**3**	**3**	**1**	**2**	**-**	**2**	**-**	**1**	**2**	**2**	**-**	**-**
CO-3	**2**	**2**	**2**	**-**	**2**	**-**	**1**	**2**	**-**	**-**	**2**	**2**
CO-4	**2**	**1**	**2**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**1**	**2**
CO-5	**2**	**2**	**1**	**1**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**-**

FEB180401: ARTIFICIAL INTELLIGENCE

Objective: It enables to fulfil varied functions like graphic rendering and file reading. It has all the resources to provide websites with different functionality and manage it smoothly at the same time. .NET provides Consistent programming model, Direct Support for Security, Simplified Development efforts and Easy application deployment and Maintenance.

Credit:4 **Semester VIII** **L-T-P:3-0-2**

Sr.	Content	Total Hrs	% Weightage
1	What is AI? :The AI Problems, The Underlying Assumption, What Is An AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word. Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.	06	14%
2	Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.	09	21%
3	Symbolic Reasoning Under Uncertainty: Introduction To Nonmonotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning : Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, DempsterShafer Theory, Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures : Conceptual Dependency, Scripts, CYC	09	23%
4	Game Playing: Overview, And Example Domain : Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative	10	24%

	deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard?, As constraint satisfaction. Natural Language Processing : Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking.		
5	Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI. Introduction to Prolog: Introduction To Prolog: Syntax and Numeric Function, Basic List Manipulation Functions In Prolog, Functions, Predicates and Conditional, Input, Output and Local Variables, Iteration and Recursion, Property Lists and Arrays, Miscellaneous Topics, LISP and Other AI Programming Languages.	**07**	**18%**

Reference Books:

1. "Artificial Intelligence" -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
2. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, PHI
3. Introduction to Prolog Programming By Carl Townsend.
4. "PROLOG Programming For Artificial Intelligence" -By Ivan Bratko(Addison-Wesley)
5. "Programming with PROLOG" –By Klocksin and Mellish.

After completion of the course, the students will be able to:

CO-1: Understanding of AI Concepts and Techniques

CO-2: Data Analysis and Preprocessing

CO-3: Algorithm Selection and Design

CO-4: Model Training and Evaluation

CO-5: Integration and Deployment

CO-6: Ethical and Social Implications

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	3	3	1	3	2	3	2	2	3
CO-2	2	2	2	2	3	2	3	2	2	2	1	3
CO-3	2	2	1	2	1	2	2	1	3	1	2	3
CO-4	2	1	2	1	2	2	1	1	2	2	1	1
CO-5	2	1	2	1	2	2	2	2	1	1	1	3
CO-6	1	1	2	1	1	2	1	1	1	2	1	2

FEB180405: CLOUD COMPUTING

Objective: The goal of cloud computing is to provide easy, scalable access to computing resources and IT services. Cloud infrastructure involves the hardware and software components required for proper implementation of a cloud computing model.

Credit:4 **L-T-P:3-0-2**

Unit	Description in detail	Hours	Weightage
I	Introduction to Cloud Technologies Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud. Virtualization and Cloud Platforms Exploring virtualization, Load balancing, Hypervisors, Machine imaging, Cloud marketplace overview, Comparison of Cloud providers.	**08**	**20%**
II	Introduction to AWS AWS history, AWS Infrastructure, AWS services, AWS ecosystem. Programming, management console and storage on AWS Basic Understanding APIs - AWS programming interfaces, Web services, AWS URL naming, Matching interfaces and services, Elastic block store - Simple storage service, Glacier - Content delivery platforms.	**09**	**25%**
III	AWS identity services, security and compliance Users, groups, and roles - Understanding credentials, Security policies, IAM abilities and limitations, AWS physical security - AWS compliance initiatives, Understanding public/private keys, Other AWS security capabilities.	**04**	**10%**
IV	AWS computing and marketplace Elastic cloud compute - Introduction to servers, Imaging computers, Auto scaling, Elastic load balancing, Cataloging the marketplace, AMIs, Selling on the marketplace. AWS networking and databases Virtual private clouds, Cloud models, Private DNS servers (Route 53), Relational database service – DynamoDB, ElastiCache, Redshift.	**09**	**20%**
V	Other AWS services and management services Analytics services, Application services, Cloud security, CloudWatch, CloudFormation, CloudTrail, OpsWorks. AWS billing and Dealing with disaster Managing costs, Utilization and tracking, Bottom line impact, Geographic and other concerns, Failure plans, Examining logs.	**10**	**25%**

Reference Books :

1. Cloud Computing Bible. Barrie Sosinsky. John Wiley & Sons. ISBN-13: 978-0470903568.
2. Amazon Web Services For Dummies. Bernard Golden. For Dummies. ISBN-13: 978-1118571835
3. RajkumarBuyya, Cloud Computing: Principles and Paradigms, John Wiley & Sons, First Edition
4. Amazon Security overview whitepaper- https://aws.amazon.com/whitepapers
5. IAM Getting started Guide http://docs.aws.amazon.com/IAM/latest/UserGuide/getting-started.html
6. Amazon.com Mashups by Francis Shanahan, Wrox, Wiley Publishing Inc.,ISBN-13: 978-0470097779, ISBN-10: 0470097779
7. Amazon Web Services in Action by Michael Wittig and Andreas Wittig, Dreamtech Press, ISBN: 9789351198758
8. Building Applications in the Cloud: Concepts, Patterns and Projects by Christopher M. Moyer, Pearson Addison-Wesley Professional, ISBN-10: 0321720202, ISBN-13: 978-0321720207
9. Cloud Computing Design Patterns by Thomas Erl, Prentice Hall, ISBN-10: 0133858561,ISBN-13: 978-0133858563

After completion of the course, the students will be able to:

CO-1: Explain the various paradigm of cloud computing and computing techniques.

CO-2: Articulate the concepts, key technologies, strength and limitation of cloud computing and possible application

CO-3: Identify the architecture and infrastructure of cloud computing including SaaS, PaaS,Iaas, public cloud, private cloud and hybrid cloud.

CO-4: Interpret various data, scalability and cloud services to acquire efficient database for cloud storage.

CO-5: Describe the appropriate cloud computing solutions and recommendations according to application used.

CO-6: Explain the core issues of cloud computing such as security, privacy and interoperability and deal with controlling mechanism for accessing sage cloud service.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	-	-	-	-	-	-	-	-	-	-

CO-2	3	3	-	-	-	-	-	-	-	-	-	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	-
CO-4	3	3	3	3	-	-	-	-	-	-	-	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	-
CO-6	3	3	3	3	-	-	-	-	-	-	-	-

FEB180407: PROJECT-III

Objective: This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college.

Credit:6 **L-T-P:0-0-12**

Course Outcome:

CO-1 : Analyze the problem, formulation and solution of the selected project.

CO-2 : Develop solutions for contemporary problems using modern tools for sustainable development..

CO-3 : Choose efficient tools for designing project modules.

CO-4 : Combine all the modules through effective team work after efficient testing.

CO-5 : Elaborate the completed task and compile the project report.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**1**	**1**
CO-2	**3**	**2**	**1**	**2**	**-**	**1**	**2**	**1**	**2**	**2**	**-**	**-**
CO-3	**2**	**1**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**2**	**2**
CO-4	**2**	**1**	**2**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**1**	**2**
CO-5	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**-**