ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. COMPUTER SCIENCE AND ENGINEERING
RUSA
REGULATIONS – 2018
I - VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	HS6151	Technical English I	HS	4	4	0	0	3	5
2.	PH6151	Engineering Physics	BS	5	3	0	2	3	5
3.	MA6151	Mathematics I	BS	4	3	1	0	3	5
4.	CS6101	Programming with C	HC	7	2	1	4	3	6
5.	CS6102	Computational Thinking	HC	4	0	0	4	3	3
			TOTAL	**24**	**12**	**2**	**10**	**15**	**24**

SEMESTER II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	HS6251	Technical English II	HS	4	4	0	0	3	5
2.	CY6251	Engineering Chemistry	BS	5	3	0	2	3	5
3.	MA6251	Discrete Mathematics	BS	4	3	1	0	3	5
4.	GE6251	Engineering Graphics	ES	6	2	0	4	3	5
5.	CS6103	Application Development Practices	HC	5	1	0	4	3	4
			TOTAL	**24**	**13**	**1**	**10**	**15**	**24**

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6104	Data Structures and Algorithms	HC	8	3	1	4	3	7
2.	CS6105	Digital Fundamentals and Computer Organization	HC	8	3	1	4	3	7
3.	MA6351	Probability and Statistics	BS	4	3	1	0	3	5
4.	EE6351	Basics of Electrical and Electronics Engineering	ES	8	4	0	4	3	7
5.		Open Elective I	OE	3	3	0	0	-	3
			TOTAL	**31**	**16**	**3**	**12**	**12**	**29**

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6106	Database Management Systems	HC	7	3	0	4	3	6
2.	CS6107	Computer Architecture	HC	5	3	0	2	3	5
3.	CS6108	Operating Systems	HC	7	3	0	4	3	6
4.		Mathematics Soft Core I	MSC	4/7	3	1/0	0/4	3	5/6
5.		Open Elective II	OE	3	3	0	0	-	3
			TOTAL	**26/29**	**15**	**1/0**	**10/ 14**	**12**	**25/26**

SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6109	Compiler Design	HC	7	3	0	4	3	6
2.	CS6110	Object Oriented Analysis and Design	HC	7	3	0	4	3	6
3.	CS6111	Computer Networks	HC	7	3	0	4	3	6
4.		Mathematics Soft Core II	MSC	4/7	3	1/0	0/4	3	5/6
5.		Professional Soft Core I	PSC	3/7	3	0	0/4	3	4/6
			TOTAL	**28/35**	**15**	**1/0**	**12/20**	**15**	**27/30**

SEMESTER VI

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.		Professional Soft Core II	PSC	3/7	3	0	0/4	3	4/6
2.		Professional Soft Core III	PSC	3/7	3	0	0/4	3	4/6
3.		Professional Soft Core IV	PSC	3/7	3	0	0/4	3	4/6
4.		Professional Elective I	PE	3	3	0	0	3	4
5.	CS6611	Creative and Innovative Project	EEC	4	0	0	4	3	3
			TOTAL	**16/28**	**12**	**0**	**12/16**	**15**	**19/25**

SEMESTER VII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.		Professional Elective II	PE	3	3	0	0	3	4
2.		Professional Elective III	PE	3	3	0	0	3	4
3.		Professional Elective IV	PE	3	3	0	0	3	4
4.		Professional Elective V	PE	3	3	0	0	3	4
			TOTAL	**12**	**12**	**0**	**0**	**12**	**16**

SEMESTER VIII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.		Professional Elective VI	PE	3	3	0	0	3	4
2.		Professional Elective VII	PE	3	3	0	0	3	4
3.	CS6811	Project Work	EEC	12	0	0	12	9	9
			TOTAL	**18**	**6**	**0**	**12**	**15**	**17**

MINIMUM NO OF CREDITS TO BE ACQUIRED:185

HUMANITIES AND SOCIAL SCIENCES (HS)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	HS6151	Technical English I	HS	4	4	0	0	3	5
2.	HS6251	Technical English II	HS	4	4	0	0	3	5

BASIC SCIENCES (BS)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	PH6151	Engineering Physics	BS	5	3	0	2	3	5
2.	MA6151	Mathematics I	BS	4	3	1	0	3	5
3.	MA6251	Discrete Mathematics	BS	4	3	1	0	3	5
4.	CY6251	Engineering Chemistry	BS	5	3	0	2	3	5
5.	MA6351	Probability and Statistics	BS	4	3	1	0	3	5

ENGINEERING SCIENCES (ES)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	GE6251	Engineering Graphics	ES	6	2	0	4	3	5
2.	EE6351	Basics of Electrical and Electronics Engineering	ES	8	4	0	4	3	7

HARD CORE (HC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6101	Programming with C	HC	7	2	1	4	3	6
2.	CS6102	Computational Thinking	HC	4	0	0	4	3	3
3.	CS6103	Application Development Practices	HC	5	1	0	4	3	4
4.	CS6105	Digital Fundamentals and Computer Organization	HC	8	3	1	4	3	7
5.	CS6104	Data Structures and Algorithms	HC	8	3	1	4	3	7
6.	CS6110	Object Oriented Analysis and Design	HC	7	3	0	4	3	6
7.	CS6109	Compiler Design	HC	7	3	0	4	3	6
8.	CS6108	Operating Systems	HC	7	3	0	4	3	6
9.	CS6106	Data Base Management Systems	HC	7	3	0	4	3	6
10.	CS6111	Computer Networks	HC	7	3	0	4	3	6
11.	CS6107	Computer Architecture	HC	5	3	0	2	3	5

MATHEMATICS SOFTCORE (MSC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	MA6201	Linear Algebra	MSC	4	3	1	0	3	5
2.	CS6201	Graph Theory	MSC	4	3	1	0	3	5
3.	EC6201	Signals and Systems	MSC	7	3	0	4	3	6
4.	CS6202	Theory of Computation	MSC	4	3	1	0	3	5

PROFESSIONAL SOFTCORES (PSC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6301	Machine Learning	PSC	7	3	0	4	3	6
2.	CS6302	Programming Paradigms	PSC	3	3	0	0	3	4
3.	CS6303	Distributed Systems	PSC	3	3	0	0	3	4
4.	CS6304	Software Engineering	PSC	3	3	0	0	3	4
5.	CS6305	Microprocessors	PSC	7	3	0	4	3	6
6.	CS6306	Parallel Programming	PSC	7	3	0	4	3	6
7.	CS6307	Advanced Algorithms	PSC	7	3	0	4	3	6
8.	CS6308	Java Programming	PSC	7	3	0	4	3	6

PROFESSIONAL ELECTIVES (PE)
TRACK - 1

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6001	Data Mining	PE	3	3	0	0	3	4
2.	CS6002	Soft Computing	PE	3	3	0	0	3	4
3.	CS6003	Big Data Analytics	PE	3	3	0	0	3	4
4.	CS6004	Information Visualization	PE	3	3	0	0	3	4
5.	CS6005	Deep Learning Techniques	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK - 2

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6006	Cloud Computing	PE	3	3	0	0	3	4
2.	CS6007	Information Security	PE	3	3	0	0	3	4
3.	CS6008	Cryptography and Network Security	PE	3	3	0	0	3	4
4.	CS6009	Mobile Networks	PE	3	3	0	0	3	4
5.	CS6010	Wireless and Sensor Networks	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK - 3

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6011	GPU Computing	PE	3	3	0	0	3	4
2.	CS6012	Embedded Systems	PE	3	3	0	0	3	4
3.	CS6013	Unix Internals	PE	3	3	0	0	3	4
4.	CS6014	IoT and Smart Appliances	PE	3	3	0	0	3	4
5.	CS6015	Multicore Architectures	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK - 4

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6016	Graphics and Multimedia	PE	3	3	0	0	3	4
2.	CS6017	Human Computer Interaction							
3.	CS6018	Image Processing	PE	3	3	0	0	3	4
4.	CS6019	Augmented Reality and Virtual Reality	PE	3	3	0	0	3	4
5.	CS6020	Digital Signal Processing	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK - 5

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
1.	CS6021	Software Testing & Quality Assurance	PE	3	3	0	0	3	4
2.	CS6022	Software Project Management	PE	3	3	0	0	3	4
3.	CS6023	Software Test Automation	PE	3	3	0	0	3	4
4.	CS6024	Test Driven Development	PE	3	3	0	0	3	4
5.	CS6025	Supply Chain Management	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK - 6

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
1.	CS6026	Game Theory	PE	3	3	0	0	3	4
2.	CS6027	Modeling and Simulation	PE	3	3	0	0	3	4
3.	CS6028	Queuing Theory and Performance Evaluation of Computer Systems	PE	3	3	0	0	3	4
4.	CS6029	Social Network Analysis	PE	3	3	0	0	3	4
5.	CS6030	Natural Language Processing	PE	3	3	0	0	3	4

PROFESSIONAL ELECTIVES (PE)
TRACK – 7

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
1.	CS6031	Database Tuning	PE	3	2	0	0	3	3
2.	CS6032	Software Defined Networks	PE	3	2	0	0	3	3
3.	CS6033	Storage Area Networks	PE	3	2	0	0	3	3
4.	CS6034	Service Oriented Architecture	PE	3	2	0	0	3	3
5.	CS6035	Entrepreneurship Development	PE	3	2	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	EL	CREDITS
THEORY									
1.	CS6611	Creative and Innovative Project	EEC	4	0	0	4	3	3
2.	CS6811	Project Work	EEC	12	0	0	12	9	9

SUMMARY

Category of Courses	HS	BS	ES	OE	HC	MSC	PSC	PE	EEC	Total
Minimum Credits to be earned	10	25	12	6	62	10	20	28	12	185

HS6151 **TECHNICAL ENGLISH I** **L T P EL C**
4 0 0 3 5

MODULE	RHETORICAL FUNCTIONS	PRIMARY FOCUS RHETORICAL FUNCTION: INTRODUCING SELF, THE LINGUISTIC ACT OF NARRATING	PRIMARY OUTCOME
MODULE 1	**SELF-INTRODUCTION. THE LINGUISTIC ACT OF NARRATING**	**Oral Fluency**: Introducing oneself-introducing friend/family (connecting campus)- **Reading**: biographies (subject based) reading strategies-skimming-scanning-predicting- **Language Focus**- Use of present and past tense forms of verbs-(Degrees of Comparison) - **Lexical Development**: Adjectives-learning topic related vocabulary (approximately 30)- **Writing**: short biographies with the given details of (related to specific branches of engineering) **Listening:** listening to speeches by specialists from various branches of engineering and completing activities such as answering questions , identifying the main ideas of the listening text, style of the speaker (tone and tenor) and making inferences.	At the end of the module, students should be able to: ▪ Introduce oneself for at least 2 minutes with minimal intrusive errors and breaks. ▪ Write a paragraph by listing information chronologically
		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work

			12 0 0 9
MODULE 2	**COMPARING AND CONTRASTING**	**Oral Fluency**: Comparing and Contrasting (e.g. Facebook and Whatsapp)- **Language Focus:** verbal phrases-compound nouns(noun strings)-simple present and present perfect , future tense-**Lexical Development**: Discourse Analysis-lexical links- related to the function of comparing and contrasting-lexical items related to the reading texts -**Reading:** texts on comparing and contrasting concepts in engineering and technology (e.g. Computers and Artificial intelligence) **Listening**: gap-filling exercises -**Writing:** Definitions(short and long)-paragraph writing especially comparing and contrasting discourse	At the end of the module, students should be able to: ▪ Compare and contrast products/ concepts both in speech and writing
		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
			12 0 0 9

		Suggested Activities	**Suggested Evaluation Methods**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
			12 0 0 9

EVALUATION METHOD TO BE USED:

MODULE 3 **MODULE 5**	**EXTENDED DISCOURSE** **STATING PROBLEMS AND EXPRESSING SOLUTIONS**	**Oral Fluency:** making mini presentations (e.g. the working of an algorithm)- **Language Focus:** use of passive voice and use of phrases- **Lexical Development:** specialist vocabulary related to process description (sequential expressions)- **Reading:** Pie chart/Table /Bar chart interpretation- **Reading** - drawing a flowchart - **Writing:** information transfer (e.g. conversion of diagrams to written forms) **Oral Fluency:** Small Group Discussion (e.g. The changing face of the software industry)- **Language Focus:** sentence level linguistic (construction of complex sentences)- vocabulary related to present perfect continuous and future tense- **Lexical Development**- (approximately 30) - **Reading** passages discussing problems and solutions (e.g. automation in the software industry and employment opportunities in the near decade)- **Listening:** TED talks & discussions- **Writing:** lengthy paragraphs- (e.g. What does the future hold for the software industry?)- Formal letter writing- highlighting problems and offering solutions.	At the end of the module, students should be able to: • Make short presentations • Read and interpret visual data • Write a process description At the end of the module, students should be able to: • Participate in small group discussions effectively • Write extended paragraphs • Listen and comprehend long talks
		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
MODULE 4	**EXPRESSING CAUSAL RELATIONS**	**Oral Fluency**- speaking skills practice in small groups. (e.g. uses and abuses of the mobile phone) **Language Focus:** use of passive voice forms of verbs – past participle forms (sentence construction for expressing causal relations)- **Lexical Development**: specialized vocabulary to establish causal relations- **Reading**: texts on cause and effect functions- texts on process description-**Listening**: filling a table, introduction to graphic presentations (pie charts, tables, pictograms) -	At the end of the module students should be able to: • Write two paragraphs describing and interpreting visual data (charts, tables etc.) • Read and comprehend texts expressing causal relations

		Writing: data interpretation and making inferences	

Sl. no	Category of Courses	Continuous Assessment	Mid –Semester Assessment	End Semester
1.	**Theory**	**40**	**20**	**40**

PH6151 ENGINEERING PHYSICS	L	T	P	EL	CREDITS
	3	0	2	3	5

Prerequisites for the course: None

OBJECTIVES:

- To introduce the basic concepts of physics.
- To develop critical thinking through problem solving related to physics
- To identify, analyze and implement possible applications with the goal of achieving the most efficient and effective usage of conceptual physics.

MODULE I :	L	T	P	EL
	3	0	2	3

Elasticity – Stress-strain diagram – cantilever – bending moment – Young's modulus determination – twisting couple.

SUGGESTED ACTIVITIES :

- In Class activity: Simple harmonic motion
- Practical - Nonuniform bending: Determination of Young's modulus.
- EL: Cantilever, Torsional pendulum, Simple harmonic oscillations

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	2	3

Torsional pendulum - rigidity modulus - moment of inertia - simple harmonic motion - Wave equation – waves on a string – wave power & intensity – sound waves – decibels.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- In class activity: Derivation and Simplification
- EL – Practical Problems - Waves – Resonance – Doppler effect of sound – standing waves in a string
- **Practical – Torsional Pendulum: Determination of rigidity modulus of wire and moment of inertia of disc.**

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	0	2	3

Noise in physical systems – noise mechanisms – ultrasonics: production – magnetostriction and piezoelectric methods – detection of ultrasonic waves– acoustic grating – ultrasonic interferometer.

SUGGESTED ACTIVITIES :

- EL: Piezoelectric effect, acoustic grating
- In class activity: Ultrasonic oscillator construction
- Practical - Ultrasonic interferometer: Determination of velocity of sound and compressibility of liquids.

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	3	0	2	3

Thermal expansion – thermal stress – bimetals – heat transfer in solids & thermal conductivity - compound media – Forbe's and Lee's disc method: theory and experiment.

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL: Thermal expansion, bimetals, Compound media, Thermal conductivity
- Practical – Lee's disc: Determination of thermal conductivity of a bad conductor.

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	0	2	3

Double and multiple slits interference – diffraction gratings – thin films – antireflection coating – Newton's rings, air-wedge and their applications – Michelson interferometer – The diffraction limit.

SUGGESTED ACTIVITIES :

- Applications in class discussion
- EL – Thin films, antireflection coating, Air-wedge, Interferometry
- Practical – Air-wedge: Determination of thickness of thin sheet/wire.

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI:	L	T	P	EL
	3	0	2	3
Lasers – Principles and applications – Einstein's coefficients – laser resonator - semiconductor laser				
SUGGESTED ACTIVITIES : • Introduction in class • EL: Laser theory, principles, industrial applications, fiber optics • Flipped Classroom for further study • Practical – Compact disc: Determination of width of groove using laser				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE VII:	L	T	P	EL
	3	0	2	3
Optical fibers – propagation of light in optical fibers – acceptance angle – numerical aperture – fiber optical communication system – fiber optic sensors.				
SUGGESTED ACTIVITIES : • Combinations of in Class & Flipped class rooms • Practical: Optical fiber: Determination of numerical aperture and acceptance angle. • EL: Fiber optics & sensors				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE VIII:	L	T	P	EL
	3	0	0	3
Wave - particle duality - The Schrodinger equation - time dependent and independent equations - expectation values - particle in a box.				
SUGGESTED ACTIVITIES : • Illustration of potential wells and tunneling phenomena in class • Flipped classroom • EL – Wave - particle duality, Schrodinger equation, Particle in a box problem (1D, 2D, 3D)				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE IX:	L	T	P	EL
	3	0	2	3
Crystal structures and packing factor (SC, BCC, FCC, Diamond) – Bragg's law – determination of crystal structures.				
SUGGESTED ACTIVITIES : • Mostly in Class • EL - Mini project for constructing crystal structures using softballs, Crystal structure parameters • Practical: Crystal structures: Classification and packing factor, Modelling of Diamond crystal structure				
SUGGESTED EVALUATION METHODS: • Assignment problems • Project demonstration and presentation (crystal structures)				
MODULE X:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Density of states – Fermi-Dirac statistics – Population of the conduction and valence bands - Fermi level – single crystal growth – epitaxy - process of integrated circuit production.				
SUGGESTED ACTIVITIES : • Combination of in class & Flipped • EL – Crystal growth techniques and IC process • Practical: Post office box: Determination of band gap of a semiconductor • Practical: Solution growth of crystal				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

REFERENCE BOOKS:

1. Richard Wolfson, "Essential University Physics", Second Edition, Addision-Wesley, 2012.
2. Narciso Garcia and Arthur Damask, "Physics for Computer Science Students", Springer-Verlag, 1991.
3. Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.
4. Harris Benson, "University Physics", Wiley India, 2004.
5. P.A. Tipler and G.P. Mosca, "Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.

OUTCOMES:

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

- Apply appropriate concepts of physics to solve problems.
- Acquire knowledge on the basics of properties of matter, optics, lasers, crystals.

- Appreciate the importance of physics of materials for various engineering applications.

EVALUATION METHOD TO BE USED:

Sl. no	Category of Courses	Continuous Assessment	Mid – Semester Assessment	End Semester
1.	**Theory Integrated with Practical**	**15(T) + 25 (P)**	**20**	**40**

MA6151 MATHEMATICS –I	**L**	**T**	**P**	**EL**	**CREDITS**
	3	**1**	**0**	**3**	**5**

OBJECTIVES:

- To gain proficiency in calculus computations.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

MODULE I SINGLE VARIABLE FUNCTIONS	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity -Continuity.

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II DIFFERENTIALCALCULUS	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Derivatives - Differentiation rules – intermediate theorem - Rolle's theorem- Maxima and Minima of functions of one variable.

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems

- Assignment problems
- Quizzes

MODULE III FUNCTIONS OFSEVERALVARIABLES	L	T	P	EL
	3	1	0	3

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problem**s**

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV MULTI VARIABLE DIFFERENTIAL CALCULUS	L	T	P	EL
	3	1	0	3

Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Flipped Class room

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V INTEGRALCALCULUS	L	T	P	EL
	3	1	0	3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI MORE ON INTEGRAL CALCULUS	L	T	P	EL
	3	1	0	3

Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction,

Integration of irrational functions - Improper integrals

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII MULTIPLEINTEGRALS	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Flipped Class room

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII VOLUME INTEGRALS	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Triple integrals – Volume of solids – Change of variables in double and triple integrals.

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Methods of variation of parameters – Method of undetermined coefficients -

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE X:	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Homogenous Equation of Euler‘s And Legendre‘s Type – System of Simultaneous Linear Differential Equations with Constant Coefficients.

SUGGESTED ACTIVITIES : • Problem solving sessions
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes

OUTCOMES:

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

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXTBOOKS:

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi,2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II,S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.

REFERENCES:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint,2010.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi,2014.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition,2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition,2009.
5. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint,2009.
6. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi,2007.

EVALUATION METHOD TO BE USED:

Sl. no	Category of Courses	Continuous Assessment	Mid – Semester Assessment	End Semester
1.	Theory	40	20	40

CS6101 PROGRAMMING WITH C	L	T	P	EL	CREDITS
	2	1	4	3	6

Prerequisites for the course: None

OBJECTIVES:

- To learn programming using a structured programming language.
- To implement programs using basic features of C.
- To learn to use C pointers and dynamically allocated memory techniques.
- To learn advanced features of the C programming language
- To be able to use file operations in C

MODULE I :	L	T	P	EL
	2	1	4	3

Notion of memory, addresses, variables, instructions, execution of instructions. Operating system commands, file editing, compiling, linking, executing a program.

SUGGESTED ACTIVITIES :

- Practical - Use of operating system commands and file editing operations.

SUGGESTED EVALUATION METHODS:

- Exercises on the use of operating system commands and file editing operations.

MODULE II :	L	T	P	EL
	2	1	4	3

Data types - constants, variables - arithmetic operators - expressions - basic input/output. Relational, logical, increment, decrement operators. Bitwise, assignment, conditional operators.

SUGGESTED ACTIVITIES :

- EL - Programs using integer type, arithmetic operators and basic input/output.
- EL - Programs using other data types and operators.
- Practical - Demonstration of programs using integer type, arithmetic operators and basic input/output.
- Practical - Demonstration of programs using other data types and operators.

SUGGESTED EVALUATION METHODS:

- Programs on integer type, arithmetic operators, basic input output.

MODULE III :	L	T	P	EL
	2	1	4	3

Statements and blocks - Selection - if-else construct - iteration - while - for constructs. The constructs else-if, switch, do-while, break, continue, enum. Pseudocode, Programming style.

SUGGESTED ACTIVITIES :

- EL: Programs using if-else, while, for.
- EL: Programs using else-if, switch, do-while, break, continue, enum. Use of pseudocode, programming style.
- Practical: Demonstration of programs using if else, while, for.
- Practical: Use of pseudocode. Demonstration of programs using else-if, switch, do-while, break, continue, enum, programming style.

SUGGESTED EVALUATION METHODS:

- Programs using if else, while, for.

MODULE IV :	**L**	**T**	**P**	**EL**
	4	**2**	**8**	**6**

Array, declaration, initialization. Multi dimensional arrays. Strings and character arrays, string operations on arrays.

SUGGESTED ACTIVITIES :

- EL - Programs using arrays and operations on arrays.
- Practical - Demonstration of programs using arrays and operations on arrays.
- EL - Programs implementing string operations on arrays.
- Practical - Demonstration of programs implementing string operations on arrays.

SUGGESTED EVALUATION METHODS:

- Evaluation: Programs using arrays and operations on arrays.
- Evaluation: Programs using strings and use of string library functions.
- Evaluation: Programs implementing string operations on arrays.

MODULE V :	**L**	**T**	**P**	**EL**
	4	**2**	**8**	**6**

Functions, definition, call, arguments, call by value. Call by reference. Recursion. Call stack. Header files, static variables, external variables.

SUGGESTED ACTIVITIES :

- EL - Programs using functions.
- Practical - Demonstration of programs using functions.
- EL - Programs using recursion.
- Practical - Demonstration of programs using recursion.

SUGGESTED EVALUATION METHODS:

- Evaluation: Programs using functions.
- Evaluation: Programs using recursion.

MODULE VI:	**L**	**T**	**P**	**EL**
	6	**3**	**12**	**9**

Pointers and arrays - address arithmetic. Dynamic Memory Allocation - Two dimensional arrays and pointers. Pointers and strings, string library functions. Pointers to functions.

SUGGESTED ACTIVITIES :

- EL - Programs using pointers and arrays, address arithmetic.
- Practical - Demonstration of programs using pointers and arrays, address arithmetic..

- EL - Programs using Dynamic Memory Allocation, two dimensional arrays and pointers.
- Practical - Demonstration of programs using Dynamic Memory Allocation, two dimensional arrays and pointers.
- EL - Programs using Pointers and strings..
- Practical - Demonstration of programs using pointers and strings.

SUGGESTED EVALUATION METHODS:

- Evaluation: Programs on pointers and arrays, address arithmetic..
- Evaluation: Programs using Dynamic Memory Allocation, two dimensional arrays and pointers.
- Evaluation: Programs using pointers and strings.

MODULE VII:	**L**	**T**	**P**	**EL**
	4	**2**	**8**	**6**

Structures, Structures and arrays. Pointers to structures, Self referential structures. Enumeration types, Unions, bit fields, typedefs.

SUGGESTED ACTIVITIES :

- EL - Programs using structures and arrays.
- Practical - Demonstration of programs using Structures and arrays.
- EL - Programs using Pointers to structures, Self referential structures.
- Practical - Demonstration of programs using pointers to structures, Self referential structures.

SUGGESTED EVALUATION METHODS:

- Evaluation: Programs using Structures and arrays.
- Evaluation: Programs using pointers to structures, self referential structures.

MODULE VIII:	**L**	**T**	**P**	**EL**
	2	**1**	**4**	**3**

Files - binary, text - open, read, write, random access, close. Preprocessor directives. Command line arguments.

SUGGESTED ACTIVITIES :

- EL - Programs using file operations in real-world applications.
- Practical - Demonstration of real-world application using file operations.

SUGGESTED EVALUATION METHODS:

- Evaluation: Demonstration of real-world application.

TEXT BOOKS:

1. Reema Thareja, “Programming in C”, 2nd ed., Oxford University Press, 2016.
2. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Pearson Education, 1988.
3. Brian W. Kernighan and Rob Pike, “The Practice of Programming” (Chap 1), Pearson Education, 1999.

REFERENCES:

1. Pradip Dey and Manas Ghosh, “Computer Fundamentals and Programming in C”, 2nd ed., Oxford University Press, 2013.
2. Yashavant Kanetkar, “Let us C”, 15th ed., BPB Publications, 2017.

3. Paul J. Deitel and Harvey Deitel, “C How to Program”, 7th ed., Pearson Education, 2013.

OUTCOMES:

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

- Apply appropriate programming constructs to solve problems.
- Write C programs for simple applications.
- Use C pointers and dynamically allocated memory to solve complex problems.
- Know advanced features of the C programming language.
- Apply file operations to develop solutions for real-world problems.

EVALUATION METHOD TO BE USED:

Continuous assessment	Mid term	End Semester
40 (P)	20	40

	L	T	P	EL	CREDITS
CS6102 COMPUTATIONAL THINKING	**0**	**0**	**4**	**3**	**3**

Prerequisites for the course: None

OBJECTIVES:

- To formulate problems in a way that enables the use of a computer to solve them.
- To logically organize and analyze data.
- To automate solutions through algorithmic thinking.
- To identify, analyze and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources.
- To generalize and transfer this problem solving process to wide variety of problems.

MODULE I :	L	T	P	EL
	0	0	4	3

Algorithmic thinking - creating oral algorithms for everyday tasks - Data abstraction and representation - Abstraction and translation of everyday data for use on a computer.

SUGGESTED ACTIVITIES :

- Explore algorithm design by creating oral algorithms.
- Abstract the essential details of everyday objects.
- Translate the description of everyday objects into data types and variables.

SUGGESTED EVALUATION METHODS:

- Evaluation of the oral algorithms and computer data.

MODULE II :	L	T	P	EL
	0	0	12	9

Decomposing a complex problem - Strategies for decomposition and algorithm design - Divide and conquer - Simple program implementations.

SUGGESTED ACTIVITIES :

- Decompose a complex problem into discrete steps,
- Design a simple algorithm for solving the problem.
- External learning: Study of different strategies for decomposition and algorithm design.
- Examine sample input and expected output and develop strategies to decompose the problem.
- Use decomposition to break the problem into smaller problems and algorithmic design to plan a solution strategy.
- External learning: Simple program implementations.

SUGGESTED EVALUATION METHODS:

- Whiteboard presentations of the decomposition and algorithm.
- Evaluation of the developed strategies.
- Demonstration of the implemented programs.

MODULE III :	**L**	**T**	**P**	**EL**
	0	**0**	**8**	**6**

Overall data representation, abstraction, analysis and algorithm design. Program implementations.

SUGGESTED ACTIVITIES :

- Examples of Data representation, abstraction, analysis and algorithm design.
- Programming implementation.

SUGGESTED EVALUATION METHODS:

- Whiteboard presentations of the Data analysis and Algorithm design.
- Demonstration of the programming implementations.

MODULE IV:	**L**	**T**	**P**	**EL**
	0	**0**	**8**	**6**

Measuring the complexity of an algorithm - sorting algorithms - the notion of unsolvable problems. Programming illustrations.

SUGGESTED ACTIVITIES :

- Develop algorithms for sorting and determine the complexity of the algorithm and how it scales as the number of items to sort increases.
- Implement the different algorithms and measure how they scale.
- Determine which algorithms are more efficient, whether or not all algorithms are calculable given enough time.

SUGGESTED EVALUATION METHODS:

- Determine complexity of algorithms and how they scale with number of items.
- Demonstration using appropriate programs.
- Determine which algorithms are computable given enough time.

MODULE V:	L	T	P	EL
	0	0	4	3
Enhancing the clarity of a program - documentation, style, idioms.				
SUGGESTED ACTIVITIES : • External Learning: Study the best practices of documentation, style, idioms, etc that are used to ensure the code can be understood and maintained over a long period. • Use these practices in the documentation of earlier programs.				
SUGGESTED EVALUATION METHODS: • Documentation of given programs.				

MODULE VI:	L	T	P	EL
	0	0	9	9
Application of computational thinking to simple real world problems - program implementation of decomposed modules.				
SUGGESTED ACTIVITIES : • Application to simple real world problems.				
SUGGESTED EVALUATION METHODS: • Evaluation of the solutions to the real world problems				

REFERENCES:

1. Exploring Computational Thinking.
https://edu.google.com/resources/programs/exploring-computational-thinking/

OUTCOMES:

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

- Abstract out details of data and represent them appropriately.
- Create appropriate algorithms to solve specified problems.
- Confidently deal with complexity and open-ended problems.
- Apply the computational thinking skills to real world problems.
- Use best practices for documentation that can ensure long term maintenance.

EVALUATION METHOD TO BE USED:

Continuous assessment	Mid term	End Semester
60	40	-

HS6251	TECHNICAL ENGLISH II		L T P EL C 4 0 0 3 5
MODULE 1	**GIVING INSTRUCTIONS AND MAKING RECOMMENDATIONS**	**Oral Fluency**: giving oral instructions and recommendations to carry out short processes. (e.g. how to maintain a smart phone)-**Language Focus:** use of imperatives and modal verbs (linguistic acts of instructing and recommending)-**Lexical Development**: learning content-related vocabulary-derivatives-functional variations (use of affixes)-stress shift-**Reading Comprehension**: language of advertising-(features)-passages discussing the uses of any particular product-**Listening**- to a product description and listing the uses of the product-**Writing-** designing an advertisement (language component of about 70-100 words)	At the end of the module, students should be able to: • Give instructions and make recommendations • Articulate sounds in English with appropriate stress shift in accordance with the meaning and grammar of words

		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
			12 0 0 9
MODULE 2	**ASKING AND ANSWERING QUESTIONS**	**Oral Fluency:** short conversations (informal) in academic institutions – Group discussions – Role play Activity -**Language Focus:** speech acts (illocutionary force; making inferences) study of language in context- framing questions (asking & answering questions) - **Lexical Development-**learning specialist vocabulary related to reading texts-**Reading-**dialogues and interviews (e.g. interviews with famous personalities)-**Writing:** dialogue writing-introduction to e-mail writing (personal)	At the end of the module, students should be able to: • Participate in conversations in informal contexts • Learn to use specialist vocabulary in appropriate contexts.
		SUGGESTED ACTIVITIES	**SUGGESTED EVALUATION METHODS**
		• Lectures on the Communicative aspects of language use. • Practical-Listening, Speaking and Writing	• Quizzes • Assignments • Small Group Work
			12 0 0 9

MODULE 3	**ASKING AND ANSWERING QUESTIONS**	**Oral Fluency**: making power point presentations (modus operandi to be given)-debating skills-**Language Focus**- use of adjectival and adverbial forms-**Lexical Development:** content related vocabulary-use of abbreviations and acronyms-**Reading**-passages on making presentations and making notes -preparation of slides-**Writing** - practice in note making and note taking- **Listening** – watching a presentation and completing a worksheet **SUGGESTED ACTIVITIES** • Lectures on the Communicative aspects of language use. • Practical- Listening, Speaking and Writing	At the end of the module, students should be able to: **SUGGESTED EVALUATION METHODS** • Make professional Power Point Presentations • Quizzes • Assignments • Power Point Presentations • Use note making and note taking skills effectively • Small Group Work
			12 0 0 9
MODULE 5	**WRITING PROJECT REPORTS**	**Oral Fluency**: Asking and answering questions (e.g. discussion on training received in school/imaginary training programme)-**Language Focus:** direct and indirect forms of narration-use of simple past and past continuous tense forms of verbs-use of modal verbs-formation of questions (interrogative and yes/no type of questions)-passive voice-**Lexical Development**: factual vs. emotive use of vocabulary-reporting verbs-**Reading:** industry /internship report-**Writing:** report on a training programme (model to be provided)-SWOT analysis- **Role Play:** going abroad for work assignments-**Language Focus**: active voice-use of punctuation marks-simple past and simple present perfect tenses-**Lexical Development**: specialist vocabulary (letter writing)-**Reading** – vision statement work summary job application-statement of purpose- **Listening:** listening to a talk and making notes- **Writing-** applying for a job (letter& e-mail) - bio data/resume **SUGGESTED ACTIVITIES** • Lectures on the Communicative aspects of language use. • Practical- Listening, Speaking and Writing	At the end of the module, students should be able to: **SUGGESTED EVALUATION METHODS** • Quizzes • Ask and answer different types of questions • Assignments • Power Point Presentations • Small Group Work • Write a purpose-oriented, factual, report
			12 0 0 9
MODULE 4	**ELABORATING ON ONE'S QUALIFICATIONS AND ACHIEVEMENTS**	**Oral Fluency:** Oral Fluency: **Listening:** to a report and completing a worksheet **SUGGESTED ACTIVITIES** • Lectures on the Communicative aspects of language use. • Practical- Listening, Speaking and Writing	At the end of the module, students should be able to: • Write a job application and draw a suitable bio data forms **SUGGESTED EVALUATION METHODS** • Quizzes • Read and understand the purposes of different types of writing • Assignments • Power Point Presentations • Small Group Work
			12 0 0 9

METHODS TO BE USED DURING CLASSROOM TEACHING

The following methods would be used to achieve programme objectives.

For language skills development:

1. Focus on fluency first for students with limited proficiency. Students would first develop the confidence to express themselves without being inhibited by errors.
2. Guided activities for speaking and writing with vocabulary and information provided as input.
3. Focus on simplicity and clarity than on the use of unnecessarily complex sentences and high- sounding words. Focus on clear organization of any spoken or written message.
4. Adequate preparation time given for demonstration of skills.
5. Sensitivity to issues of shyness and introversion and avoiding coercive methods.
6. Use of relevant techno- social topics on which students have opinion.
7. Use of listening and reading to improve vocabulary.
8. Peer evaluation using feedback templates to allow students to practice in small groups on their own. A session with 30 students needs to allow adequate opportunity to all students.
9. Teacher correction of individual writing scripts with feedback.

FOR COMMUNICATION SKILLS DEVELOPMENT:

1. Focus on essential and time- tested principles of communication that are applicable in most contexts.
2. Avoiding formulae but providing basic templates that can be adapted to situations.
3. Avoiding complex behavioral theories or pop psychology as communication guides.
4. Using situations that students would typically encounter on campus and later at work.
5. Gradual building of confidence by progressing from communication in front of small groups to communication in front of larger groups.

ASSESSMENT

Skills other than speaking would be tested using a paper and pencil test. Speaking skills will be tested using a verbal test.

TEXTBOOK:

1. ENGLISH Today: Technical Communication for Science, Engineering and Technology. Board of Editors, Department of English, Anna University. Orient Black Swan (Volumes 1&2) 2017.

REFERENCES:

1. Learning to Communicate: Dr. V. Chellammal, Allied Publishers, 2002.
2. English for Technical Communication: N.P. Sudharshana, C. Savitha, Cambridge University Press, 2016.

EVALUATION METHOD TO BE USED:

Sl. no	Category of Courses	Continuous Assessment	Mid –Semester Assessment	End Semester
1.	Theory	40	20	40

CY6251 ENGINEERING CHEMISTRY	L	T	P	EL	CREDITS
	3	0	2	3	5

OBJECTIVES:

- To develop an understanding about fundamentals of polymer chemistry, preparation and properties of polymers
- To acquire knowledge in photochemistry and spectroscopy
- To understand the concepts of surface chemistry and catalysis.
- To impart basic knowledge on chemical thermodynamics.
- To get acquainted with the basic concepts of nano chemistry.
- To understand the chemistry of the fabrication of integrated circuits
- To know the types of specialty materials used in the electronics/electrical industry.

MODULE I :	L	T	P	EL
	3	0	2	3

Polymer Chemistry: Introduction: Functionality; Classification of Polymers- Natural and Synthetic, Thermoplastic and Thermosetting. Types and Mechanism of Polymerization: Addition (Free Radical, Cationic, Anionic and Living); Condensation and Copolymerization. Piezo and pyro electric polymers; Photoresists – Positive and negative.

SUGGESTED ACTIVITIES :

- In Class activity for Functionality and Mechanism of polymerisation
- Practical – Thermal free radical polymerisation of styrene/MMA

SUGGESTED EVALUATION METHODS:

- Tutorial : Deduce type of polymer from monomers with different functionalities
- Assignment : Predicting mechanism of polymerization for few important monomers
- Quizzes

MODULE II :	L	T	P	EL
	3	0	2	3

Properties of Polymers: T_g, Tacticity, Degree of Polymerization & Molecular Weight - Weight Average, Number Average and Polydispersity Index. Techniques of Polymerization: Bulk, Emulsion, Solution and Suspension

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- Proofs and Simplification in class
- Practical – Determination of molecular weight of PVA using Ostwald viscometer

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	0	2	3

Photochemistry: Electromagnetic Radiation - Laws of Photochemistry - Grotthuss-Draper Law, Stark-Einstein Law and Lambert-Beer Law. Photo Processes - Internal Conversion, Inter-System Crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-Sensitization.

SUGGESTED ACTIVITIES :

- Evaluate quantum efficiency for different systems
- Photo Processes – in class and EL based on that
- Practical – Estimation of sodium in water sample by flame photometry

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	3	0	2	3

Spectroscopy: Absorption of Radiation-Electronic, Vibrational and Rotational Transitions. Width and Intensities of Spectral Lines. Spectrophotometric Estimation Of Iron. UV-Vis and IR Spectroscopy-Principles, Instrumentation (Block Diagram) and Applications

SUGGESTED ACTIVITIES :

- Flipped Class room
- Types of electronic/vibrational transitions for different molecules – in class and EL based on that
- Practical – Estimation of iron in water sample by spectrophotometry

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	0	2	3

Adsorption-Types of Adsorption-Adsorption of Gases on Solids- Adsorption from Solutions- Types of Isotherms – Frendlich Adsorption Isotherm, Langmuir Adsorption Isotherm. Industrial Applications of Adsorption.

SUGGESTED ACTIVITIES :

- Industrial applications in class
- EL – Adsorption of gases on solids
- Practical – Adsorption of acetic acid/oxalic acid on charcoal – verification of Freundlich's adsorption isotherm.

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment
- Quizzes

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Catalysis: Characteristics and Types of Catalysts-Homogeneous and Heterogeneous, Auto Catalysis. Enzyme Catalysis - Factors Affecting Enzyme Catalysis, Michaelis - Menton Equation. Industrial Applications of Catalysts

SUGGESTED ACTIVITIES :

- Introduction in class
- Analysis in Class
- Flipped Classroom for further study
- Practical – Determination of rate constant of acid catalysed hydrolysis of an ester

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Second Law: Entropy-Entropy of Phase Transitions; Free Energy- Gibbs-Helmholtz Equation; Clausius Clapeyron Equation; Van't Hoff Isotherm and Isochore. Chemical Potential; Gibbs-Duhem Equation- Variation of Chemical Potential with Temperature and Pressure.

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- Practical – Phase change in a solid.
- EL - HDL descriptions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Nano chemistry - Basics-Distinction between Molecules, Nanoparticles and Bulk Materials; Size-Dependent Properties. Preparation of Nanoparticles – Sol-Gel and Solvo - thermal. Preparation of Carbon Nanotube by Chemical Vapour Deposition and Laser Ablation. Preparation of Nanowires by Electrochemical Deposition and Electro Spinning. Properties and Uses of Nanoparticles, Nanoclusters, Nanorods, Nanotubes and Nanowires.

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- EL – Properties and uses of Nanowires, nanoclusters, nanorods, nanowires
- Practical - Preparation of nano wire by electrospinning

SUGGESTED EVALUATION METHODS:

- Tutorial
- Assignment
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Fabrication of integrated circuits: Introduction – Fabrication – MOS – NMOS, PMOS, CMOS, Ga-As Technologies, Printed circuit boards-Fabrication (Single layer only) – Lamination, printing (photo and screen printing) and
mechanical operation.

SUGGESTED ACTIVITIES :

- Mostly in Class
- EL - Mini project for Lamination by Hand lay up Technique
- Practical – Determination of total, temporary and permanent hardness of water by EDTA method

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Project demonstration and presentation

MODULE X:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Specialty Materials: Dielectrics & insulating materials – Characteristics; Ceramics – Mica and glass; Magnetic materials – basis of magnetism – Soft and hard magnetic materials; Composites : Classification – Particulate, fibrous and laminated composites – Hybrid composites – Application of composites in electrical and electronic components; Semiconductors – Extensive and intensive; Metallic solids –Characteristics.

SUGGESTED ACTIVITIES :

Combination of in class & Flipped

SUGGESTED EVALUATION METHODS:

- Tutorial
- Assignment
- Quizzes

PREREQUISITES FOR THE COURSE:

Laboratory facilities to carry out the experiments mentioned in each of the modules – Thermal free radical polymerisation of styrene/MMA,Determination of molecular weight of PVA using Ostwald viscometer, Estimation of sodium in water sample by flame photometry, Estimation of iron in water sample by spectrophotometry, Adsorption of acetic acid/oxalic acid on charcoal – verification of Freundlich's adsorption isotherm, Determination of rate constant of acid catalysed hydrolysis of an ester, Phase change in solid, Electrospinning, Total and temporary hardness.

OUTCOMES

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

- Identify the different types of polymers, polymerisation processes and some special properties and applications of polymers.
- Identify suitable adsorbents/ adsorption process and catalysts for pollution abatement and other industrial processes.
- Discuss the concepts involved in the absorption of radiation by materials and various photophysical processes, polymer chemistry, surface chemistry and catalysis.
- Point out the spectral techniques for qualitative and quantitative analysis & thermodynamics of various processes.
- Discuss the importance of the nano materials (and their superiority over conventional materials), feasibility of their preparation and uses
- Elaborate on various technologies for the fabrication of integrated circuits & specialty materials in the electronics/electrical industry

TEXT BOOKS:

1. Jain P.C and Monika Jain, "Engineering Chemistry", Dhanpet Rai Publishing Company (P) Ltd.,New Delhi, 2013.
2. Wong M.N., "Polymer for electronics and photonic applications", John Wiley, New York, 2006.

REFERENCES:

1. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012
2. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.
3. Khanna O.P.," Material Science" NIH Publications, 2007.

EVALUATION METHOD TO BE USED:

Continuous assessment	Mid term	End Semester
15(T) + 25 (P)	20	40

MA6251 DISCRETE MATHEMATICS	L	T	P	EL	CREDITS
	3	1	0	3	5

MODULE I LOGIC	L	T	P	EL
	3	1	0	3

Propositional Logic – Propositional equivalences - Predicates and Quantifiers – Nested Quantifiers

SUGGESTED ACTIVITIES :

- Problem Solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems

- Quizzes

MODULE II PROOFS	L	T	P	EL
	3	1	0	3

Rules of inference - Introduction to proofs – Proof methods and strategy.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III COMBINATORICS	L	T	P	EL
	3	1	0	3

Mathematical induction – Strong induction and well ordering – The basics of counting - The pigeonhole principle- Permutations and Combinations

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV RECURRENCES	L	T	P	EL
	3	1	0	3

Recurrence relations -Solving linear recurrence relations using generating functions – Inclusion - Exclusion Principle and its applications.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V GRAPH THEORY	L	T	P	EL
	3	1	0	3

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Flipped class room
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI ALGEBRAIC STRUCTURE 1	L	T	P	EL
	3	1	0	3

Algebraic systems – Semi groups and monoids – Groups - Subgroups - Homomorphisms

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII ALGEBRAIC STRUCTURE 2	L	T	P	EL
	3	1	0	3

Normal subgroup and coset - Lagrange‟s theorem – Definitions and examples of Rings and Fields

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Flipped Class room

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII LATTICES	L	T	P	EL
	3	1	0	3

Partial ordering – Posets – Lattices as Posets – Properties of lattices - Lattices as algebraic systems – Sub lattices

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX BOOLEAN ALGEBRA	L	T	P	EL
	3	1	0	3

Direct product and Homomorphism – Some special lattices – Boolean algebra

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

OUTCOMES:

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

- Identify techniques to test the logic of a program.
- Identify structures at many levels.
- Work with a class of functions which transform a finite set into another finite set which relates to input and output functions in Computer Science.
- Discuss the counting principles.
- Point out the properties of algebraic structures such as groups, rings and fields.

TEXT BOOKS:

1. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 7th Edition, Special Indian edition, 2011.
2. Tremblay J.P. and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011. 22.
3. Susanna S. Epp, “Discrete Mathematics with Applications” Cengage Learning, New Delhi, 8th Edition, 2016.

REFERENCES:

1. Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education Asia, Delhi, 4th Edition, 2007.
2. Thomas Koshy,” Discrete Mathematics with Applications”, Elsevier Publications, 2006. 3
3. Seymour Lipschutz and Mark Lipson, ”Discrete Mathematics”, Schaum‟s Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

	L	T	P	EL	CREDITS
GE6251 ENGINEERING GRAPHICS	**2**	**0**	**4**	**3**	**5**

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

MODULE I :	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Importance of Graphics in Engineering Applications – Use of Drafting Instruments – BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning.

SUGGESTED ACTIVITIES :

- Demonstration using CAD software to bring out the concepts presented in the subject
- Hands on practicals on open source software

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE II :	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Basic Geometrical Constructions, Curves used in Engineering Practices - Conics –Construction of Ellipse,Parabola and Hyperbola by Eccentricity Method – Construction of Cycloid – Construction of Involutes of Square and Circle – Drawing of Tangents and Normal to the above Curves.

SUGGESTED ACTIVITIES :

- Videos of application of Geometric curves in various domains
- Theory and mathematics in class
- EL – Practical Problems
- Practical –Construction of curves

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Visualization Concepts and Free Hand Sketching: Visualization Principles – Representation of Three Dimensional Objects – Layout of Views - Free Hand Sketching of Multiple Views from Pictorial Views of Objects

SUGGESTED ACTIVITIES :

- Building models using various media
- Discussing uses of multiple views in various fields
- Practical - Construction of 3D views

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	2	0	4	3

Orthographic Projection- Principles - Principal Planes - First Angle Projection - Projection of Points. Projection of Straight Lines (only First Angle Projections) Inclined to Both the Principal Planes - Determination of True Lengths and True Inclinations by Rotating Line Method and Trapezoidal Method and Traces

SUGGESTED ACTIVITIES :

- Videos of application of projections in various domains
- Theory and mathematics in class
- EL – Practical Problems in orthographic projection of points
- Practical –Construction of curves

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	2	0	4	3

Projection of Planes (Polygonal and Circular Surfaces) Inclined to both the Principal Planes by Rotating Object Method.

SUGGESTED ACTIVITIES :

- Videos of application of projections in various domains
- Theory and mathematics in class
- EL – Practical Problems in orthographic projection of planes

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI:	L	T	P	EL
	2	0	4	3

Projection of Simple Solids like Prisms, Pyramids, Cylinder, Cone and Truncated Solids when the Axis is Inclined to both the Principal Planes by Rotating Object Method and Auxiliary Plane Method.

SUGGESTED ACTIVITIES :

- Introduction in class
- Models making
- Videos/software demonstrations

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII	L	T	P	EL
	2	0	4	3

Sectioning of Solids in Simple Vertical Position when the Cutting Plane is Inclined to the one of the Principal Planes and Perpendicular to the other – Obtaining True Shape of Section.

SUGGESTED ACTIVITIES :

- Introduction in class
- Models
- Videos */*software demonstrations

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Development of Lateral Surfaces of Simple and Sectioned Solids – Prisms, Pyramids Cylinders and Cones. Development of Lateral Surfaces of Solids with Cut-Outs and Holes.

SUGGESTED ACTIVITIES :

- Development models in cardboard
- Software demonstration

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Principles of Isometric Projection – Isometric Scale – Isometric Projections of Simple Solids and Truncated Solids - Prisms, Pyramids, Cylinders, Cones - Combination of Two Solid Objects in Simple Vertical Positions and Miscellaneous Problems.

SUGGESTED ACTIVITIES :

- Videos
- Demonstrations using Solid modeling software

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE X	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

Perspective Projection of Simple Solids - Prisms, Pyramids and Cylinders by Visual Ray Method and Vanishing Point Method.

SUGGESTED ACTIVITIES :

- Videos
- Illustration using Advertisements

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

OUTCOMES:

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

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production”,Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P)Limited ,2008.
5. K. V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, “ Engineering Drawing”, Oxford University Press, 2015.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

EVALUATION METHOD TO BE USED:

Sl. no	Category of Courses	Continuous Assessment	Mid – Semester Assessment	End Semester
1.	**Theory**	**40**	**20**	**40**

CS6103 APPLICATION DEVELOPMENT PRACTICES	L	T	P	EL	TOTAL	CREDITS
	1	0	4	3	8	4

OBJECTIVES:

- To introduce students to programming languages and techniques associated with the world wide web and thereby create interest in programming even to students with little programming knowledge
- To introduce tools for creating interactive web pages
- To introduce the client-server architecture
- To introduce databases

MODULE I :	L	T	P	EL
	1	0	4	3

Design of webpages – Use of Cascading style sheets to style the way a webpage looks

SUGGESTED ACTIVITIES :

- EL – Learn to use CSS

SUGGESTED EVALUATION METHODS:

- Demonstration of designed webpages
- Evaluation of the preparation done in learning CSS syntax

MODULE II :	L	T	P	EL
	1	0	4	3

Incorporating multimedia into a webpage (Text / Audio / Image / Video / Animation)

SUGGESTED ACTIVITIES :

- EL – Learn how to read information from a file/array and display on the webpage

SUGGESTED EVALUATION METHODS:

- Demonstration of having incorporated multimedia in a webpage

MODULE III :	L	T	P	EL
	1	0	4	3

Writing client side scripts using Javascript / Angular JS
Client side validation

SUGGESTED ACTIVITIES :

- EL – Learn to use Javascript / Angular JS

SUGGESTED EVALUATION METHODS:

- Demonstration of using client side validation for designed web browsers

MODULE IV:	L	T	P	EL
	1	0	4	3

Designing a static website using content management frameworks

SUGGESTED ACTIVITIES :

- EL – Familiarity with any one content management framework

SUGGESTED EVALUATION METHODS:

- Evaluation of the preparation done in getting familiarized with a content management framework

MODULE V :	L	T	P	EL
	1	0	4	3
Understanding servers – Server login, Database connectivity				
SUGGESTED ACTIVITIES : • EL- Overview of databases				
SUGGESTED EVALUATION METHODS: • Quiz on servers and overview of databases				
MODULE VI:	**L**	**T**	**P**	**EL**
	4	**0**	**0**	**2**
Use queries for fetching from database Processing the results of queries File upload/download File streaming				
SUGGESTED ACTIVITIES : • EL - SQL queries to create table, select, update and insert				
SUGGESTED EVALUATION METHODS: • Quiz on SQL queries • Demonstration of the use of queries				
MODULE VII:	**L**	**T**	**P**	**EL**
	1	**0**	**4**	**3**
Server side scripts and validation				
SUGGESTED ACTIVITIES : • EL – Learn how to write server side scripts				
SUGGESTED EVALUATION METHODS: • Demonstration of the use server side scripts				
MODULE VIII:	**L**	**T**	**P**	**EL**
	1	**0**	**4**	**3**
Development of web application				
SUGGESTED ACTIVITIES : • EL - Select an application for which webpage has to be developed. List the features to be included.				
SUGGESTED EVALUATION METHODS: • Oral explanation of the web application to be developed				
MODULE iX:	**L**	**T**	**P**	**EL**
	1	**0**	**4**	**3**
Development of web application				
SUGGESTED ACTIVITIES : • EL – Application of what was learnt in the previous weeks and develop the webpage				
SUGGESTED EVALUATION METHODS: • Demonstration of developed web application				

OUTCOMES:

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

- Develop interactive websites
- Use of databases
- Understand and appreciate the use of the client-server architecture

REFERENCES:

1. Scobey, Pawan Lingras, "Web Programming and Internet Technologies An E-Commerce Approach", Second Edition, Jones & Bartlett Publishers, 2016.

EVALUATION METHOD TO BE USED:

Sl. no	Category of Courses	Continuous Assessment	Mid – Semester Assessment	End Semester
1.	Practical Integrated with Theory	40(P)	20(T)	40(P)

CS6104 DATA STRUCTURES AND ALGORITHMS

Prerequisites for the course: NIL

OBJECTIVES:

- To understand the concepts of linear and non-linear data structures
- To get an idea about suitability of data structure for an application
- To learn some fundamental algorithm design strategies
- To understand how the correctness of an algorithm can be proved
- To learn how to analyze an algorithm
- To understand the concept of NP-Completeness

CS6104	DATA STRUCTURES AND ALGORITHMS	L	T	P	EL	CREDITS
		3	1	4	3	7

MODULE I	INTRODUCTION	L	T	P	EL
		4	1	0	4

Abstract Data Types – Algorithm Properties – Overview on Proof of Correctness & Algorithm Analysis – Asymptotic Notations & Properties, Linear Search.

SUGGESTED ACTIVITIES :

- Workout on design of algorithms for some small simple problems, provide proof of correctness, and determine the complexity.
- EL - Study on average case analysis for some standard algorithms.

SUGGESTED EVALUATION METHODS:

- Assignment - Based on design, correctness and efficiency.

MODULE II LINEAR DATA STRUCTURES	L	T	P	EL
	4	1	4	3

Stack - Queue - Linked lists - Some applications based on linear data structures.

SUGGESTED ACTIVITIES :

- EL – Converting an algorithm from recursive to non-recursive using stack.
- Practical - An application based on linear data structure.

SUGGESTED EVALUATION METHODS:

- Programming exercises in the laboratory
- Quizzes

MODULE III NON-LINEAR DATA STRUCTURES	L	T	P	EL
	4	1	4	3

Trees - Graphs - Traversals - Threaded binary trees.

SUGGESTED ACTIVITIES :

- EL - Applications of trees and graphs.
- Practical - Implementing tree and graph traversals.

SUGGESTED EVALUATION METHODS:

- Assignment related to application
- Programming exercises in the laboratory
- Quizzes

MODULE IV DIVIDE & CONQUER	L	T	P	EL
	4	1	4	3

Strassen's Matrix Multiplication - Selection in Linear Time.

SUGGESTED ACTIVITIES :

- EL – Merge Sort & Quick Sort
- Practical – Implementation of Merge Sort & Quick Sort.

SUGGESTED EVALUATION METHODS:

- Programming exercises in the laboratory
- Assignment problems
- Quizzes

MODULE V GREEDY METHOD	L	T	P	EL
	4	1	4	3

Greedy Strategy – Knapsack Problem - Spanning Trees –Single Source Shortest Path problems

SUGGESTED ACTIVITIES :

- EL – Tree Vertex Splitting
- Practical – Spanning Tree Implementation

SUGGESTED EVALUATION METHODS:

- Programming exercises in the laboratory
- Quizzes

MODULE VI DYNAMIC PROGRAMMING	L	T	P	EL
	4	1	4	3
Principles of Optimality - Matrix chain multiplication - Longest common subsequences				
SUGGESTED ACTIVITIES : ● EL – All Pair shortest path. ● Practical - Implementation of All pair shortest path				
SUGGESTED EVALUATION METHODS: ● Programming exercises in the laboratory ● Quizzes				

MODULE VII BACKTRACKING & BRANCH AND BOUND	L	T	P	EL
	4	1	4	3
Backtracking:8-Queens & Sum of subsets – Branch & Bound: 0/1 Knapsack				
SUGGESTED ACTIVITIES : ● Flipped class rooms ● Practical - Implementations of sum of subset problem. ● EL –Travelling Salesperson using Branch & Bound				
SUGGESTED EVALUATION METHODS: ● Programming exercises in the laboratory ● Assignment problems ● Quizzes				

MODULE VIII MORE ON SORTING & INDEXING	L	T	P	EL
	5	1	4	3
Heap Sort – External sorting – Hashing				
SUGGESTED ACTIVITIES : ● EL – Comparison of internal sorting algorithms ● Practical – Implementation of Hash table				
SUGGESTED EVALUATION METHODS: ● Programming exercises in the laboratory ● Quizzes				

MODULE IX STRING MATCHING	L	T	P	EL
	2	1	2	2
Naïve Algorithm – KMP Algorithm				
SUGGESTED ACTIVITIES : ● Tutorial ● Practical – Implementation of KMP algorithm				
SUGGESTED EVALUATION METHODS: ● Programming exercises in the laboratory ● Quizzes				

MODULE X NP-COMPLETENESS	L	T	P	EL
	5	1	0	5
Polynomial time verification – Theory of reducibility - NP Completeness proof for Vertex cover &Hamiltonian Cycle.				
SUGGESTED ACTIVITIES : EL – Study of proof for NP completeness on any two problems				
SUGGESTED EVALUATION METHODS: ● Quizzes				

TEXT BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, Galgotia, 1976.
2. Ellis Horowitz and Sartaj Sahni, “Fundamental of Computer Algorithms”, Galgotia, 1985.
3. Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice Hall, 2010.

REFERENCES:

1. Jean-Paul Tremblay and Paul G Sorenson, “An Introduction to Data Structures with Applications”, Second Edition, Tata McGraw Hill, 1991.
2. Kenneth A. Berman and Jerome L Paul, “Algorithms”, Cengage Learning India, 2010.

OUTCOMES:

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

- Point out various representations of data structures
- Write functions to implement linear and non–linear data structure operations
- Suggest and use appropriate linear/non–linear data structure operations for solving a given problem
- Apply various algorithm design techniques and analysis
- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval
- Show how to prove a problem to be NP-Complete

Evaluation Pattern:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12
CO1	√											
CO2					√							
CO3	√	√	√									
CO4	√			√	√							
CO5	√	√			√							√
CO6	√	√	√									

CS6105 DIGITAL FUNDAMENTALS AND COMPUTER ORGANIZATION

Prerequisites for the course: None

OBJECTIVES:

- To learn Boolean algebra and simplification of Boolean functions
- To learn to design and analyze different combinational circuits
- To study the basics of synchronous sequential logic and analyze and design sequential circuits
- To understand the important components of a computer system and the basic organization
- To learn to write code in hardware definition languages for designing larger digital systems

CS6105 DIGITAL FUNDAMENTALS AND COMPUTER ORGANIZATION	L	T	P	EL	CREDITS
	3	1	4	3	7

MODULE I :	L	T	P	EL
	3	1	4	3

Number Systems – Binary, Octal, Hexadecimal – Representation of negative numbers - 1's and 2's Complements - Arithmetic Operations – Binary Codes.

SUGGESTED ACTIVITIES :

- In Class activity for place - value systems
- Practical – Abacus – Counting – Activity

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	1	4	3

Boolean Algebra – Theorems and Postulates - Functions – Truth Table - Logic Gates – Universal gates

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- Proofs and Simplification in class
- EL – Practical Problems - Introduction to propositional problems using conjunction, disjunction and negation
- Practical - Implementation of simple functions using gates

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	1	4	3

Canonical and Standard Forms – Minterms and Maxterms - Sum of Products and Product of Sums - Simplification of Boolean Functions - Karnaugh Map – 2,3,4 variables - NAND / NOR Implementations.

SUGGESTED ACTIVITIES :

- EL - Exclusive OR function
- Practical - Simplification and implementation of Boolean functions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	6	1	8	3

Combinational Circuits – Arithmetic Circuits - Half and Full Adders - Subtractors - Binary Parallel adder – Carry Look-ahead Adder - BCD Adder - Magnitude Comparator - Binary multiplier - Code Converters. Introduction to HDL.

SUGGESTED ACTIVITIES :

- Flipped Class room
- Introduction to HDL – in class and EL based on that
- Practical - Implementation of the arithmetic circuits and getting started with HDL

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	1	8	3

Decoder, Encoder, Priority Encoder, Mux/Demux - Applications. HDL for these circuits.

SUGGESTED ACTIVITIES :

- Applications in class
- EL – HDL for these combinational circuits
- Practical - Implementation of these circuits and HDL implementations

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI:	L	T	P	EL
	5	1	4	3

R –S Latch - D Latch - Flip flops – SR, JK, T, D, Master /Slave FF, HDL for latches and flip flops - Analysis of clocked sequential circuits – Moore /Mealy models - Flip flop excitation tables - Design of clocked sequential circuits.

SUGGESTED ACTIVITIES :

- Introduction in class
- Analysis in Class
- Flipped Classroom for further study
- Practical - Implementation of Flip flops

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**1**	**4**	**3**

Registers – Shift Registers, Universal Shift Register Counters – Ripple Counters, Synchronous Counters, Ring Counter, Johnson Counter - HDL for counters and shift registers

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- Practical - Implementations of counters and shift registers
- EL - HDL descriptions
- EL - Mini project for designing and implementing a digital system using both hardware and software (HDL)

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**1**	**4**	**3**

Practical Problems in Sequential design – Timing diagrams - Problems combining Combinational & Sequential Components – State reduction – State Assignment

SUGGESTED ACTIVITIES :

- Timing diagrams in class
- Flipped classroom
- Practical - HDL descriptions to be continued

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**1**	**4**	**3**

Memory Systems – RAM, ROM, PLD, PLA and PAL - Design of digital systems

SUGGESTED ACTIVITIES :

- Combination of in class & Flipped
- Practical - Project demonstration and presentation

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE X:	L	T	P	EL
	3	1	4	3
Basic Components of a digital computer - Functions - Organization - Instruction Execution - Data path and control path				
SUGGESTED ACTIVITIES : • Mostly in Class • Practical - Project demonstration and presentation				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, V Edition, Pearson Education, 2013.
2. Charles H. Roth Jr, “Fundamentals of Logic Design”, Fifth Edition, Jaico Publishing House, Mumbai, 2003.

REFERENCES:

1. John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007.
2. Donald D. Givone, “Digital Principles and Design”, Tata McGraw Hill, 2003.
3. G. K. Kharate, “Digital Electronics”, Oxford University Press, 2010.

OUTCOMES:

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

- Simplify complex Boolean functions
- Design and analyze digital circuits with combinational and sequential components
- Implement digital circuits using MSI chips and PLDs
- Use HDL to build digital systems
- Point out the basic functionalities of the components of a digital computer and their organization

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓		✓			✓					

MA6351 PROBABILITY AND STATISTICS	L	T	P	EL	TOTAL CREDITS
	3	1	0	3	5

OBJECTIVES:

- To provide students with the basic concepts of probability theory
- To equip the students with essential tools for statistical analyses at the graduate level.
- To Foster understanding through real-world statistical applications.

MODULE I RANDOM VARIABLES	L	T	P	EL
	3	1	0	3

Discrete and continuous random variables – Moments – Moment generating functions

SUGGESTED ACTIVITIES :

- Problem Solving sessiTons
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II DISTRIBUTIONS	L	T	P	EL
	4	2	0	3

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III TWO - DIMENSIONAL RANDOM VARIABLES	L	T	P	EL
	4	2	0	3

Joint distributions – Marginal and conditional distributions

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV CORRELATION	L	T	P	EL
	4	2	0	3

Covariance – Correlation and Linear regression

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V TRANSFORMATION OF RANDOM VARIABLES	**L**	**T**	**P**	**EL**
	6	**2**	**0**	**3**

Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI TESTING OF HYPOTHESIS (Large Samples)	**L**	**T**	**P**	**EL**
	6	**2**	**0**	**3**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII TESTING OF HYPOTHESIS (Small Samples)	**L**	**T**	**P**	**EL**
	6	**2**	**0**	**3**

Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII DESIGN OF EXPERIMENTS	L	T	P	EL
	6	2	0	3

Analysis of variance – One way and two-way classification – Completely Random Design.

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX STATISTICAL QUALITY CONTROL	L	T	P	EL
	4	2	0	3

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts)

SUGGESTED ACTIVITIES :

- Problem Solving sessions
- Seminar by students
- Application in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

OUTCOMES :

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

- Use statistical methodology and tools in the engineering problem-solving process
- Describe the properties of discrete and continuous distribution functions
- Use method of moments and moment generating functions
- Compute point estimation of parameters
- Apply the Central Limit Theorem
- Use statistical tests in testing hypotheses on data

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.

REFERENCES:

1. Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes ", Mc Graw Hill Education India , 4th Edition, New Delhi , 2010.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

Evaluation Pattern:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓						✓	✓
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							
CO6	✓	✓	✓	✓	✓							

EE6351	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**EL**	**TOTAL CREDITS**
		4	**0**	**4**	**3**	**7**

Prerequisites for the course: None

OBJECTIVES :

- To learn the steady state DC and AC characteristics of electric circuits
- To understand the working of DC/AC motors, transformer and generators
- To understand the functionality of basic electronic circuits namely amplifiers, filters, data converters and oscillators
- To learn the design aspects of basic amplifier configurations and concepts of feedback techniques

MODULE I :	**L**	**T**	**P**	**EL**
	2	**0**	**4**	**3**

DC Electrical circuit - Fundamental laws– Steady State Solution of DC Circuits – Electrical measuring instruments.

SUGGESTED ACTIVITIES :

- Computer simulation of DC circuits problems and solution
- EL- Solving of complex electrical networks using circuit theorems
- Practical – Basic electrical circuit measurements and verification of circuit theorems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Introduction to AC Circuits –Sinusoidal steady state analysis– Power and Power factor – Single Phase and Three Phase Balanced Circuits.

SUGGESTED ACTIVITIES :

- Computer simulation of AC circuits problems and solution
- EL- Solving of other engineering problems as electrical circuit equivalents
- Practical – Three phase power measurements

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors

SUGGESTED ACTIVITIES :

- EL- Survey of commonly used DC machines and their applications
- Practical – Load test on DC motor and generator

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Operating principle of Transformers –Induction Motor – single phase and three phase operation, Stepper motor

SUGGESTED ACTIVITIES :

- Study of utility power grid and the use of transformers
- EL- Survey of commonly used AC machines and their applications
- Practical – Load test on transformer and Induction motor

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Characteristics of PN Junction Diode, Half wave and Full wave Rectifiers, Zener Diode and its Characteristics – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics.

SUGGESTED ACTIVITIES :

- Practical - V- I characteristics of PN Junction and Voltage regulator characteristic of Zener Diode,
- Demonstration - Half wave and Full wave Rectifiers

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Elementary Treatment of Small Signal Amplifier – Linear Amplifier, Biasing Requirement – Voltage Divider Biasing, Basic CE amplifier circuit - Small signal equivalent model - Small signal Voltage gain

SUGGESTED ACTIVITIES :

- Practical – CE amplifier Voltage Divider Biasing and verification of operating point, Verification of small signal voltage gain

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Differential amplifier using BJT, Negative feedback amplifier – characteristics – topologies, Opamp - inverting amplifier - non inverting amplifier.

SUGGESTED ACTIVITIES :

- Practical - Opamp characteristics:
  Verification of inverting amplifier gain
  Verification of non inverting amplifier gain

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Opamp based circuit – Summer – Subtractor – Integrator – Differentiator, Opamp based Filters – Low pass, High pass, Band pass, Band reject.

SUGGESTED ACTIVITIES :

- Practical -Verification of opamp based arithmetic circuit
  Verification of frequency response characteristics of opamp based First order lowpass filter,First order highpass filter

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Analog to Digital Converter – Flash ADC- Successive Approximation ADC, Digital to Analog Converter – Binary weighted DAC, Positive feedback – Ring oscillator.

SUGGESTED ACTIVITIES :

- Presentation / Assignment on
  Performance metrics of ADC
  Ring oscillator circuit architecture

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE X:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

MOSFET – V-I characteristics, MOSFET small signal equivalent circuit, Common Source amplifier – Voltage gain – Frequency response characteristic.

SUGGESTED ACTIVITIES :

- Spice simulation - MOSFET V-I characteristic

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

OUTCOMES:

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

- Compute steady state solution of DC and AC electric circuits
- Analyze the characteristics of motors and transformers
- Design and analyze amplifiers
- Characterize the frequency response of BJT based amplifiers
- Realize arithmetic circuits, basic filter configurations using opamp
- Point out the characteristics of data converters

TEXT BOOKS:

1. J Nagarath and Kothari DP, "Electrical Machines", Tata McGraw Hill, 2010.
2. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.

REFERENCES:

1. P.C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2nd Edition, 2007.
2. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013.
3. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum's Outline Series, McGraw Hill, 2002.
4. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
5. A.E. Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education (India) Private Limited, 2009.
6. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010.
7. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University Press, 2014.
8. Coughlin and Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall, 1989.

Evaluation Pattern:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	15(T) + 25 (P)	20	40

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓					✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓	✓			✓			
CO5	✓	✓		✓		✓	✓		✓	✓		✓

CS 6106 DATA BASE MANAGEMENT SYSTEMS

Pre-requisites for the course: None

OBJECTIVES:

- To learn the fundamentals of data models and to conceptualize and represent a database system using ER diagram
- To study the principles to be followed to create an effective relational database design and effectively write SQL queries to retrieve/ store data from/to database
- To know the fundamental concepts of transaction processing-concurrency control techniques and recovery procedure
- To have an introductory knowledge about the storage and query processing techniques and the basic concepts of Information retrieval techniques
- To learn about the internal storage structures using different file and indexing techniques which will help in physical DB design

DATABASE MANAGEMENT SYSTEMS	**L**	**T**	**P**	**EL**	**CREDITS**
	3	**0**	**4**	**3**	**6**

MODULE I:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**2**

Introduction to Databases- File System Vs Database System - Data Models- Schemas and Instances - DBMS Architecture- Centralized - Client Server - Database Applications

SUGGESTED ACTIVITIES:

- In class activity for various database applications

SUGGESTED EVALUATION METHODS:

- Tutorial: scenarios to analyze the need for DB in various applications
- Practical - Installation of Open Source DBMS software and perform basic DB operations like creating sample tables and populating the instances
- Quizzes

MODULE II:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Entity Relationship (ER) Model - conceptual design of DB Application - ER diagram - Design issues - Relationship types - other notations - Extended Entity-Relationship (EER) Model - ER to Relational Mapping

SUGGESTED ACTIVITIES:

- In class activity: defining the participating entities and their relations for a given scenario
- Practical –Use OSS to draw the ERD depicting the attributes, cardinality and other relationships

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III:	L	T	P	EL
	6	0	4	6
Relational Data Model - Operations on Relational Model - Specifying Constraints Relational Algebra - Unary, Binary, Set and other Operations - Tuple and Domain Relational Calculus. SQL - Data Definition - Data Manipulation and Retrieval Queries				
SUGGESTED ACTIVITIES: • In Class - ER Model to Relational Model mapping • Practical - ER Modeling using open source tools and Schema realization				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				
MODULE IV:	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**
Database Design - Functional Dependencies - Normal Forms - 1 NF - 2 NF - 3 NF - BCNF - Multivalued Dependency - Join Dependency				
SUGGESTED ACTIVITIES: • In Class - Normalization • Flipped class room - Database design validation through Normalization, Understanding the functional dependency across the attributes in the relation. • Practical – Creation of schema using Data Definition language and Instances using the Data Manipulation language commands • Practical – Simple SQL query construction using keywords				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				
MODULE V:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Complex SQL Queries - Nested Queries - Correlated Nested Queries - Various Types of Joins - Aggregate Functions - Grouping - Triggers – Views – Embedded and Dynamic SQL				
SUGGESTED ACTIVITIES: • In Class - SQL Queries and Joins • Practical - Implementation of complex SQL Queries (Joins, Sub queries, inbuilt functions) and Triggers • EL – Understand the features in other commercial or open-source DBMS				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				
MODULE VI:	**L**	**T**	**P**	**EL**
	5	**0**	**4**	**3**
Transaction processing concepts -Need for concurrency control and recovery- ACID Properties - Recoverability - Serializability				

SUGGESTED ACTIVITIES:

- In Class –examples to understanding the real-world scenarios like concurrency in transactions
- Practical - Implementation of complex procedures (PL/SQL Procedures) and transactions involving shared variables

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Concurrency Control - Two phase locking Techniques - Timestamp Ordering - Granularity - Recovery - Deferred Update - Immediate Update - Deadlocks

- In Class – examples to understanding the real-world scenarios like concurrency, deadlock and recovery in transactions
- Practical - Implementation of complex procedures (PL/SQL functions) and transactions involving shared variables

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Query Processing - SQL Query Translation - Pipelining - Query Optimization - Cost Estimation - Semantic Query Optimization

SUGGESTED ACTIVITIES:

- EL – Methods for optimizing the query in terms of space and time complexity
- In Class - Query Translation and Optimization
- Flipped classroom - cost-based query optimization for complex SQL queries
- Practical – Cost estimation for a query using OSS

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Indexing - Single-Level and Multilevel Index - Multiple Key Index - Indexing Issues. Hashing

SUGGESTED ACTIVITIES:

- EL – efficient methods for storage and retrieval
- In Class - Selecting the Index types for a scenario and discuss the efficiency
- Flipped Classroom – Issues on selection of attribute in a relation for Indexing / Hashing
- Practical – Use OSS to compare the efficiency of the various available methods of storage and retrieval

SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				
MODULE X:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Introduction to Database Tuning - Data Warehousing and Mining – Spatial and Temporal Databases – OO Databases, NoSQL				
SUGGESTED ACTIVITIES: • EL – Applications that use Spatial and temporal data • In Class – Analyzing the tuning parameters that corresponds to high performance. • Flipped Classroom – Demonstrate the operations on Data in Data warehouse & mine specific patterns • Practical – Use OSS to perform the operations in DW & M				
SUGGESTED EVALUATION METHODS: • Assignment problems • Project demonstration and presentation				

OUTCOMES:

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

- Model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model
- Formulate solutions to a broad range of query problems using relational algebra/ SQL
- Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database
- Run transactions and estimate the procedures for controlling the consequences of concurrent data access
- Discuss the basic database storage structures and access techniques: file and page organizations, indexing methods including B-tree, and hashing
- Point out the basics of query evaluation techniques and query optimization

TEXT BOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson/Addison - Wesley, 2016.

REFERENCES:

1. C.J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson Education, Eighth Edition, 2006.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill, 2014.
3. Narain Gehani and Melliyal Annamalai, "The Database Book: Principles and Practice Using the Oracle Database System", Universities Press, 2012.
4. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley, 2012.

EVALUATION METHOD TO BE USED:

Continuous assessment	Mid term	End Semester
15(T) + 25 (P)	20	40

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓		✓	✓							
CO3	✓		✓	✓	✓							
CO4	✓	✓		✓								
CO5	✓	✓			✓							
CO6	✓	✓	✓	✓								

CS 6107 COMPUTER ARCHITECTURE

Prerequisites for the course: None

OBJECTIVES:

- To identify the requirements of different types of computer systems
- To understand the evaluation of computer systems based on various performance metrics
- To study the characteristics of the ISA and the hardware software co-design
- To trace the execution sequence of an instruction through the processor
- To compare different approaches used for implementing a functional unit
- To understand the fundamentals of memory and I/O systems and their interaction with the processor

COMPUTER ARCHITECTURE	L	T	P	EL	CREDITS
	3	0	2	3	5

MODULE I :	L	T	P	EL
	3	0	2	3

Introduction - Classes of computer systems - Performance - Amdahl's law - The Power wall - Switch from uniprocessors to multiprocessors – Benchmarks.

SUGGESTED ACTIVITIES :

- In Class activity for performance evaluation
- EL - Evolution of computer systems, identification of benchmarks
- Practical – Demonstration - Opening up a computer system and studying the components

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	2	3

Hardware Software Interface - ISA - Operations of the computer hardware - Operands - Representing instructions - Instructions for making decisions - Supporting procedures in computer hardware.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Writing simple assembly language programs from high level code
- Practical – Study of an existing standard architectural simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	0	2	3

Addressing modes - Translating and starting a program - Arrays versus pointers - MIPS instruction formats - Assembly language programming.

SUGGESTED ACTIVITIES :

- EL - Familiarising with assembly language programming
- Practical - Study of an existing standard architectural simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	3	0	2	3

Integer arithmetic - Binary Parallel adder – Carry Look-ahead Adder - Carry save adder - Binary multiplier - Booth's multiplier - Bit-pair recoding - Binary division.

SUGGESTED ACTIVITIES :

- Flipped Class room
- Some arithmetic algorithms in class and some as EL
- Practical : Study of addressing modes with examples, Tracing the execution sequences, Identifying the timing constraints

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	0	2	3

Floating point arithmetic- Representation - Arithmetic operations on floating point numbers - Parallelism and computer arithmetic.

SUGGESTED ACTIVITIES :

- Flipped class room
- EL – Simulation of the floating point operations
- Practical - Study of the ISA supported by the architectural simulator and running simple programs on the simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes
- Demonstrate decode and execute for a subset of instructions on the simulator

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Datapath design - Implementation of the basic MIPS ISA - Building the datapath - A simple implementation scheme - Drawbacks.

SUGGESTED ACTIVITIES :

- Introduction in class
- Flipped Classroom for building of datapath for additional instructions
- Practical - Analysing the datapath on the standard simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quiz in Class or automatic Quizzes for the flipped classroom content

MODULE VII:	**L**	**T**	**P**	**EL**
	6	**0**	**2**	**6**

Instruction Level Parallelism - Pipelining - Overview of pipelining - Performance - Pipeline hazards - Pipelined datapath and control - Handling data hazards and control hazards - Exceptions - Introduction to advanced ILP.

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- Practical - Study of the pipelined implementation and analysis of various hazards on the standard simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems involving instruction sequences and real-time scenarios
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	6	**0**	**4**	**6**

Need for a hierarchical memory system - The basics of caches - Measuring and improving cache performance. Virtual memory - Paging and segmentation - TLB - Implementing protection with virtual memory. A common framework for memory hierarchies, Associative memories, Introduction to virtual machines.

SUGGESTED ACTIVITIES :

- Flipped classroom
- Practical - Implement a simple functional model of a set-associative cache in C/C++. Study hit/miss rates for various access patterns. Experiment with different replacement policies.

- EL - Writing simple programs to study the behaviour of the memory hierarchy of your own laptop/ PC
  - Analyzing the performance of the memory hierarchy by varying different parameters

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes
- Practical component evaluation

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**2**	**3**

Storage and I/O - Dependability, reliability and availability - Disk storage - Flash storage - Connecting processors, memory and I/O devices - Interfacing I/O devices to the processor, memory and the operating system, Designing an I/O system, Parallelism and I/O, RAID.

SUGGESTED ACTIVITIES :

- EL - Survey of storage devices (NAS/SAN/RAID etc.) on different classes of systems
- Practical – Continue with the exercises on memory hierarchy

SUGGESTED EVALUATION METHODS:

- Survey evaluation – mindmap

OUTCOMES:

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

- Evaluate the performance of computer systems
- Design a simple instruction execution unit
- Point out the hazards present in a pipeline and suggest remedies
- Explain the data path and control path implementation of a processor
- Modify some features of an architectural simulator
- Critically analyse the various characteristics of the hierarchical memory and I/O devices and their interface to the processor

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Fifth Edition, Morgan Kaufmann / Elsevier, 2013.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCE BOOKS:

1. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Sixth Edition, Pearson Education, 2003.
2. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998.
3. V.P. Heuring, H.F. Jordan, “Computer Systems Design and Architecture”, Second Edition, Pearson Education, 2004.
4. Behrooz Parhami, “Computer Architecture”, Oxford University Press, 2007.

EVALUATION METHOD TO BE USED:

Continuous assessment	Mid term	End Semester
15(T) + 25 (P)	20	40

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓				✓		✓	✓
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓	✓				✓			✓
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓	✓	✓				✓			✓
CO6	✓	✓										✓

CS 6108 OPERATING SYSTEMS

Prerequisites for the course: None

OBJECTIVES:

- To learn the basic concepts and functions of operating systems
- To learn the mechanisms of operating systems to handle processes and threads and their communication
- To know the components and management aspects of concurrency management
- To study the basic components of scheduling mechanism
- To learn the mechanisms involved in memory management in contemporary OS
- To appreciate the emerging trends in Operating Systems
- To learn programmatically to implement simple OS mechanisms

OPERATING SYSTEMS	L	T	P	EL	TOTAL	CREDITS
	3	0	4	3		6

MODULE I INTRODUCTION TO OPERATING SYSTEMS	L	T	P	EL
	4	0	4	4

Introduction to OS – Operating System Services – Operating System Operations – Virtualization – User and Operating System Interface – System Calls – Operating System Structures - Building and Booting an Operating System

SUGGESTED ACTIVITIES:
PRACTICAL:
l - Shell programming assignments

EL

1. Shell programming
2. Read the history of Unix/Linux/Windows
3. Know the operating system in your phone/laptop
4. System boot up process of Windows / Linux

SUGGESTED EVALUATION METHODS:

- Quiz on understanding of Linux and shell programming

MODULE II INTRODUCTION TO PROCESSES	**L**	**T**	**P**	**EL**
	6	**0**	**8**	**6**

Process Concept – Process Scheduling – Context Switch – Operations on Processes – Inter-process Communication – IPC in Shared-Memory Systems – IPC in Message-Passing Systems Examples of IPC Systems – POSIX shared memory

SUGGESTED ACTIVITIES :

Practical:

1. Use of ps, ps lx, ps tree, ps –aux commands
2. Use of top command to display resource usage statistics of processes
3. Use of the fork, clone, exec, wait, exit system calls
4. Inter-process communication using pipes, shared memory

EL: Learn to write a makefile, to use gdb and to use grep

SUGGESTED EVALUATION METHODS:

- Implementation evaluation
- EL assignment to be appropriately evaluated

MODULE III THREADS	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Threads – Overview – Multithreading models – Pthreads

SUGGESTED ACTIVITIES :

Practical:

Implement multi-threading using the Pthread library

EL: Java threads

SUGGESTED EVALUATION METHODS:

- Evaluation of the implementation of multi-threading

MODULE IV CPU SCHEDULING	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Basic Concepts of CPU Scheduling – Scheduling Criteria – Scheduling Algorithms

SUGGESTED ACTIVITIES :

Practical:

Simulation of CPU scheduling algorithms

EL:

Assignment problems on CPU scheduling algorithms

SUGGESTED EVALUATION METHODS:

- Assignments to be appropriately evaluated.

MODULE V PROCESS SYNCHRONIZATION	**L**	**T**	**P**	**EL**
	6	**0**	**8**	**6**
The Critical-Section Problem - Peterson's Solution – Hardware Support for Synchronization – Mutex Locks – Semaphores – Monitors				

SUGGESTED ACTIVITIES:

Practical:

1. Solutions to Syncronization problems using semaphores
2. Introduction to xv6: download and build
3. Run the kernel inside QEMU gdb

EL:

Reading details about xv6 operating system

SUGGESTED EVALUATION METHODS:

- Implementation evaluation
- Quiz on the understanding of the different concepts in this module

MODULE V STORAGE MANAGEMENT	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**4**
File Concept – Access Methods – Directory Structure – Protection – Directory Implementation – Allocation Methods – Free-Space Management – Disk Structure – Disk Scheduling				

SUGGESTED ACTIVITIES:

Practical:

1. Use of system calls like creat, open, read, write, close, dup, readdir and scandir
2. Read the file xv6/fs.h to understand how a directory entry, a superblock and the contents of an inode are implemented in xv6
3. Read the file xv6/fs.c to understand how a new entry is added to a directory and explain the functions involved.

EL:

Read about the contents of a superblock, a directory entry, and an inode in UNIX-like operating systems

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE VI MEMORY MANAGEMENT	**L**	**T**	**P**	**EL**
Contiguous Memory Allocation – Paging – Structure of the Page Table – Segmentation – Paging with segmentation	**6**	**0**	**8**	**6**

SUGGESTED ACTIVITIES :

Practical:

1. Read and understand appropriate files in xv6 related to process scheduling and memory management

EL:

Assignment problems on memory management

SUGGESTED EVALUATION METHODS:

- Quiz on xv6 study files

MODULE VII VIRTUAL MEMORY MANAGEMENT	L	T	P	EL
	3	0	4	3
Demand Paging – Page Replacement – Allocation of Frames – Thrashing				

SUGGESTED ACTIVITIES

Practical:

- Implementation of at least one of the page replacement policies
- Implementation of a new system call in xv6

EL:

- Assignments on page replacement algorithms

SUGGESTED EVALUATION METHODS

- Evaluation of the coding assignments
- Quiz on the different parts of the module

OUTCOMES:

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

- Articulate the main concepts, key ideas, strengths and limitations of Operating Systems
- Analyze the structure and basic architectural components of OS
- Elaborate and design various scheduling algorithms
- Discuss various memory management schemes and design them
- Point out the various aspects of storage management

TEXT BOOK:

1. Abraham Silberschatz, Greg Gagne and Peter B. Galvin. "Operating System Concepts", 10th Edition, Wiley, 2018.

REFERENCES:

1. Andrew S. Tanenbaum. "Modern Operating Systems", Addison Wesley, Fourth Edition, 2014.
2. D. M. Dhamdhere. "Operating Systems: A Concept-Based Approach", 3rd. Edition, Tata McGraw-Hill, 2017.
3. William Stallings. "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2013.
4. Russ Cox, Frans Kaashoek and Robert Morris. "xv6: A Simple, Unix-like Teaching Operating System", Revision 8. (Free and can be downloaded)

SOURCE CODE

The xv6 source code is available via : *git clone git://pdos.csail.mit.edu/xv6/xv6.git*

EVALUATION METHOD TO BE USED:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓					✓				✓	✓
CO2	✓	✓		✓	✓	✓					✓	✓
CO3	✓	✓	✓	✓	✓		✓				✓	✓
CO4	✓	✓	✓	✓	✓	✓					✓	✓
CO5	✓	✓				✓	✓				✓	✓

CS 6109 COMPILER DESIGN

OBJECTIVES:

- To know about the various transformations in the different phases of the compiler, error handling and means of implementing the phases
- To learn about the techniques for tokenization and parsing
- To understand the ways of converting a source language to intermediate representation
- To have an idea about the different ways of generating assembly code
- To have a brief understanding about the various code optimization techniques

COMPILER DESIGN	L	T	P	EL	CREDITS
	3	0	4	3	6

MODULE I :	L	T	P	EL
	3	0	4	3
Phases of the compiler – compiler construction tools – role of assemblers, macroprocessors, loaders, linkers.				
SUGGESTED ACTIVITIES : • EL – Constructs of programming languages - C, C++, Java • LEX tool tutorial				
SUGGESTED EVALUATION METHODS: • Tutorial problems				

- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE II :	L	T	P	EL
	3	0	4	3

Role of a lexical analyzer – Recognition of Tokens – Specification of Tokens - Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon Transitions – NFA to DFA conversion - Minimization of Automata.

SUGGESTED ACTIVITIES :

- EL –LEX tool for tokenization
- Problems based on conversion from NFA to DFA, Epsilon NFA to DFA
- Practical – Programs using LEX for tokenization

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE III :	L	T	P	EL
	3	0	4	3

Error handling – Error Detection and Recovery – Lexical phase error management – Syntax phase error management -Error recovery routines.

SUGGESTED ACTIVITIES :

- Flipped Class room – LEX programs
- Problems based on obtaining automata for error routines.
- EL – Implementation of error recovery procedures using LEX/FLEX tool

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE IV :	L	T	P	EL
	3	0	4	3

Context-Free Grammar (CFG) – Derivation Trees – Ambiguity in Grammars and Languages – Need and Role of the parser

SUGGESTED ACTIVITIES :

- EL - CFG for C language constructs
- Problems to check for ambiguity

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	0	4	3

Recursive Descent Parsers – LL(1) Parsers – Shift Reduce Parser – LR(0) items - Simple LR parser

SUGGESTED ACTIVITIES :

- EL – Push down automata for Parsing, YACC tutorial.
- Problems based on simplification of CFG

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI:	L	T	P	EL
	3	0	4	3

LALR Parser – CALR Parser – Parser Generators – Design of a parser generator

SUGGESTED ACTIVITIES :

- EL – YACC tutorial for parsing particular language syntaxes
- Practical – programs using YACC for parsing

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE VII:	L	T	P	EL
	3	0	4	3

Syntax directed Definitions – Inherited and Synthesized Attributes - Syntax Directed Translation - Construction of Syntax Tree-Type Systems-Specification of a simple type checker

SUGGESTED ACTIVITIES :

- EL – Type checking semantic rules for a programming language like C.
- Programs for validating C-lite constructs using YACC

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	L	T	P	EL
	3	0	4	3

Three address code – Types of Three address code – Quadruples, Triples, Three-address code for Declarations, Arrays, Loops, Backpatching

SUGGESTED ACTIVITIES :

- Flipped classroom – semantic rules for three-address code a programming language like C.
- Practical – implementation of three-address code generation for a programming language like C.
- EL – Three-address code for Switch-case statements
- Assignment on generating three-address code for arrays, looping constructs with and without backpatching

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Run Time Environment: Source Language Issues- Symbol Tables - Storage Organization-Stack Allocation- Access to nonlocal data on stack – Heap management - Parameter Passing

SUGGESTED ACTIVITIES :

- Flipped classroom – suggested parameter passing techniques for a programming language like C.
- Practical – Symbol table implementation

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Practical demo / evaluation

MODULE X:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Basic blocks – Next use – Register allocation – DAG construction – Loops

SUGGESTED ACTIVITIES :

- Combination of in class & Flipped
- EL – Basic block, next-use applications,
- EL – alternate register allocation techniques
- Practical – Implementation of Register allocation using Graph colouring

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE XI:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Code Generator Issues – Simple Code generator – Data Structures for simple code generator, Labelling algorithm - Code generator using DAG – Dynamic programming based code generation

SUGGESTED ACTIVITIES :

- Combination of in class & Flipped
- EL – Template based code generation
- Practical – simple code generator for a programming language like C.

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical demo / evaluation

MODULE XII:	L	T	P	EL
	3	0	4	3
Principle sources of optimization - Optimization in Basic blocks – DAG – Structure Preserving transformation – functional transformation – loop optimization – Peep hole optimization				
SUGGESTED ACTIVITIES : • Combination of in class & Flipped • Practical – Combining and integrating all the implemented features for a programming language like C				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes • Practical demo / evaluation				

TEXT BOOK:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education Limited, 2014.

REFERENCES:

1. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint, 2003.
3. Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Morgan Kaufmann Publishers, Elsevier Science, 2004.
4. V. Raghavan, “Principles of Compiler Design”, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, “Compiler Design in C”, Prentice-Hall Software Series, 1993.

OUTCOMES:

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

- Comprehensively identify the issues in every phase of the compiler
- Analyse the design issues in the different phases of the compiler and design the phases by integrating appropriate tools
- Identify the apt code generation strategy that needs to be adopted for any given source language
- Analyse and understand the various code optimizations that are necessary for any given intermediate code or assembly level code for sequential algorithms
- Apply and design code optimization techniques for any input code with error recovery
- Design a compiler by incorporating the various phases of the compiler for any new source language

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	15(T) + 25 (P)	20	40

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓	✓	✓					✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓				✓	✓
CO4	✓	✓	✓	✓	✓	✓					✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓				✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓

CS6110 OBJECT ORIENTED ANALYSIS AND DESIGN

Prerequisites for the course: None

OBJECTIVES:

- To capture the requirements specifications of an intended software system
- To design software with static and dynamic UML diagrams
- To map the design properly to code
- To improve the software design with design patterns
- To test the software against its requirements specifications

OBJECT ORIENTED ANALYSIS AND DESIGN	L	T	P	EL	CREDITS
	3	0	4	3	6

MODULE I :	L	T	P	EL
	3	0	4	3

Introduction to OOAD with OO Basics - Unified Process – UML diagrams

SUGGESTED ACTIVITIES :

- EL - Identifying a suitable case study to work on for a complete end-end implementation
- EL – Document the Software Requirement Specifications(SRS) for the identified case study
- Practical – Getting familiar with the case tool

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	4	3
Use Cases –Case study – the Next Gen Point of Sale(POS) system, Inception Use case Modelling				
SUGGESTED ACTIVITIES : • EL – Identify use cases for the chosen case study and develop the Use Case model. • Practical – Presenting the SRS for the chosen case study and obtaining approval				
SUGGESTED EVALUATION METHODS: • Presentations • Quizzes				

MODULE III :	L	T	P	EL
	3	0	4	3
Use case modeling - Relating Use cases – include, extend and generalization - Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes				
SUGGESTED ACTIVITIES : 1. EL - Identify the conceptual classes to develop a DomainModel and Class Diagram. 2. Practical – Presenting the use case model (for the chosen case study) along with use case diagrams.				
SUGGESTED EVALUATION METHODS: • Presentations • Quizzes				

MODULE IV :	L	T	P	EL
	3	0	4	3
Domain Modeling using class diagrams - Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition				
SUGGESTED ACTIVITIES : • EL – Expand the domain model by identifying the hierarchies, association, aggregation and composition • Practical – Present the refined use case model and the basic domain model				
SUGGESTED EVALUATION METHODS: • Presentations • Quizzes				

MODULE V :	L	T	P	EL
	3	0	4	3
Dynamic Diagrams - UML interaction diagrams - System sequence diagram – Collaboration diagram - Communication diagram				

SUGGESTED ACTIVITIES :

- EL – Develop sequence diagrams for the scenarios identified in the use case model
- Practical – Presenting the complete domain model(after refinement) and class diagrams for the chosen case study

SUGGESTED EVALUATION METHODS:

- Presentations
- Quizzes

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

State machine diagram and Modelling – State Diagram - Activity diagram

SUGGESTED ACTIVITIES :

- EL - Develop state and activity diagrams for the chosen case study
- Practical – Presenting the dynamic model with sequence diagrams

SUGGESTED EVALUATION METHODS:

- Presentations
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Implementation Diagram - UML package diagram - Component and Deployment Diagrams

SUGGESTED ACTIVITIES :

- EL –Finalize the environment and initiate implementation
- Practical – Presenting the complete dynamic model with state and activity diagrams and refined sequence diagrams

SUGGESTED EVALUATION METHODS:

- Presentations
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller. Design Patterns – Creational – Factory method – Structural – Bridge – Adapter – Behavioural– Strategy – Observer

SUGGESTED ACTIVITIES :

- EL– Continue with the implementation
- Practical – Demonstrate partial implementation

SUGGESTED EVALUATION METHODS:

- Practical demonstration
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Applying Gang of Four design patterns – Mapping design to code

SUGGESTED ACTIVITIES :

- EL – Identifying suitable design patterns to improve the design and documenting the rationale behind their selection. Proceed with the refined implementation by applying them,
- Practical **–** Demonstrate complete implementation without the design patterns

SUGGESTED EVALUATION METHODS:

- Practical demonstration
- Quizzes

MODULE X:	L	T	P	EL
	3	0	4	3

Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans

SUGGESTED ACTIVITIES :

- EL – Developing a Test plan with all test cases
- Practical – Present the modified design with appropriate design patterns. Demonstrate the implementation after incorporating the implementation of suitable design patterns

SUGGESTED EVALUATION METHODS:

- Presentations
- Quizzes

MODULE XI	L	T	P	EL
	2	0	4	0

Revisiting and consolidating all salient points and key insights based on the team projects

Suggested Activities:

- Practical – Demonstrating the test plan and the various test cases

Suggested Evaluation:

- Presentations

OUTCOMES:

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

- Identify and map basic software system requirements in UML
- Express software design with UML diagrams
- Design and implement software systems using OO methodology
- Improve software design using design patterns
- Test the software system developed against the intended requirements

TEXT BOOK:

1. Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, 3rd. Edition, Pearson Education, 2005.

REFERENCES:

1. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third Edition, Addison Wesley, 2003.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Reusable Object-Oriented Software”, Pearson, 2015.

EVALUATION METHOD TO BE USED:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓	✓		
CO2	✓	✓	✓	✓	✓				✓	✓		
CO3	✓	✓	✓	✓	✓	✓			✓	✓		
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓	✓	✓							✓

CS 6111 COMPUTER NETWORKS

CS 6111 COMPUTER NETWORKS	L	T	P	EL	CREDITS
	3	0	4	3	6

OBJECTIVES

- To understand the division of network functionality into layers
- To familiarize the functions and protocols of each layer of the TCP/IP protocol suite
- To visualize the end-to-end flow of information
- To understand the components required to build different types of networks
- To learn concepts related to network addressing and routing

MODULE I :	L	T	P	EL
	3	0	8	3

Building a network - Network edge and core – Layered Architecture – ISO/OSI Model – Internet Architecture (TCP/IP) - Performance Metrics – Introduction to Sockets.

SUGGESTED ACTIVITIES :

- Performance Metrics – In class
- EL - Socket Programming
- Practical – Socket Programming

SUGGESTED EVALUATION METHODS:

- Problems on Performance Metrics

MODULE II :	L	T	P	EL
	4	0	8	3

Application Layer protocols – HTTP- FTP – Email – DNS

SUGGESTED ACTIVITIES :

- EL - HTTP/DNS format using Wireshark
- Practical – Implementation of HTTP, Web Caching, FTP using socket programming

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quiz on Wireshark

MODULE III :	L	T	P	EL
	3	0	4	3
Transport Layer: End to End Protocols – Connectionless Transport: User Datagram Protocol – UDP Applications.				
SUGGESTED ACTIVITIES : • EL - Wireshark for UDP, TCP packet formats • Practical – Socket Programming on UDP**,** Implementation of DNS using UDP				
SUGGESTED EVALUATION METHODS: • Quiz on UDP applications				

MODULE IV :	L	T	P	EL
	6	0	4	3
Connection Oriented Transport: Transmission Control Protocol – Flow Control - Retransmission strategies - Transport layer for Real Time Applications - Congestion Control				
SUGGESTED ACTIVITIES : • EL – Transport layer for Real Time Applications • Analysis in Class – Flow Control • Practical – Flow Control				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quiz on Real time transport protocols				

MODULE V :	L	T	P	EL
	3	0	4	2
Network Layer: Introduction- Internet Protocol – IPV4 - IP Addressing				
SUGGESTED ACTIVITIES : • EL- IPV6 • Practical – Basic network construction using simulator				
SUGGESTED EVALUATION METHODS: • Assignment Problems • Quizzes				

MODULE VI	L	T	P	EL
	3	0	0	3
Subnetting – Variable Length Subnet Mask (VLSM) - Classless Inter Domain Routing (CIDR) - DHCP – ICMP				
SUGGESTED ACTIVITIES : • In class – Problems on Subnetting, • EL – Problems on CIDR				
SUGGESTED EVALUATION METHODS: • Assignment Problems				

MODULE VII:	L	T	P	EL
	3	0	8	4
Routing Principles – Distance Vector Routing – Link State Routing – RIP – OSPF – SDN Control Plane				
SUGGESTED ACTIVITIES :				

- In Class – Problems in Distance Vector Routing , Link State Routing
- EL - RIP, OSPF
- Practical – Performance analysis of different network topologies and routing protocols using suitable simulator

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

BGP- Introduction to Quality of Services (QoS). Data Link Layer: Link Layer – Framing – Addressing – Error Detection/ Correction

SUGGESTED ACTIVITIES

- In class: Error Detection and Correction
  EL – Problems on QoS

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	6	**0**	**0**	**3**

Medium Access Control – Address Resolution Protocol (ARP) – Network Address Translation (NAT) - Ethernet Basics - CSMA/CD - Virtual LAN – Wireless LAN (802.11) – WAN Technologies

SUGGESTED ACTIVITIES :

- EL – RARP

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE X:	**L**	**T**	**P**	**EL**
	5	**0**	**4**	**3**

Physical layer: signals - Bandwidth and data rate - Encoding - Multiplexing - Transmission media - Networking devices: Hubs, Bridges, Switches, Routers, Gateways.

SUGGESTED ACTIVITIES :

- In class – Encoding techniques problems
- EL – Recent developments in transmission media
- Practical – Topology setup using Hubs, Switches and Bridges using simulator.

SUGGESTED EVALUATION METHODS:

- Quizzes

OUTCOMES:

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

- Highlight the significance of the functions of each layer in the network
- Identify the devices and protocols to design a network and implement it
- Build network applications using the right set of protocols and estimate their performance
- Trace packet flows and interpret packet formats

- Apply addressing principles such as subnetting and VLSM for efficient routing
- Explain media access and communication techniques

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Seventh Edition, Pearson Education, 2016.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.

REFERENCES:

1. William Stallings, “Data and Computer Communications”, Eighth Edition, Pearson Education, 2011.
2. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, " Computer Networks: An Open Source Approach", 1st Edition, McGraw Hill, 2011.

EVALUATION METHOD

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓		✓				✓			✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓	✓								✓

CS6611	CREATIVE AND INNOVATIVE PROJECT	L	T	P	EL	C
		0	0	4	3	3

OBJECTIVES:

- To identify the problem based on societal needs
- To interview people on societal problems that require computerization
- To suggest creative solutions to societal problems
- To explore possible alternative solutions
- To estimate risk and develop a prototype

The aim of this course is to encourage the students to identify projects that help in exploring variables that promote creativity and innovation. Each student is expected to choose a real life or socially relevant problem. At the end of the project, students should be familiar with the state of art in their respective fields. They would be able to apply the concepts learnt to relevant research problems or practical applications. This course is to motivate them to learn concepts, models, frameworks, and tools that engineering graduates' need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.

OUTCOMES:

Upon completion of this course, the students will be able to

- Convert user requirements to a software architecture diagram
- Identify and specify the pre-processing necessary to solve a problem
- Suggest optimum solutions by comparing the different solutions from an algorithmic perspective
- Discover the research implications in any societal problem
- Design and use performance metrics to evaluate a designed system
- Perform SWOT and PESTEL Analysis

1. Internals

a. First Review
   i. Block Diagram of the proposed solution for a societal / creative problem
   ii. New Contribution in terms of modifications to existing algorithm or suggestion of new ones
   iii. Detailed Design of each module
   iv. Evaluation Metrics
   v. Test Cases

b. Second Review
   i. Implementation - Justifying pros and Cons
   ii. Coding - highlighting what has been reused and what is being written

c. Third Review
   i. Test Runs
   ii. Performance Evaluation based on Metrics
   iii. Project Documentation

2. Externals

- Presentation, Viva-Voce, Report submission.

OUTCOMES:

Upon completion of the course, the students will be able to

- Assess the needs of the society
- Describe the background of the problem
- Formulate a problem
- Perform SWOT and PESTEL Analysis

- Frame a policy
- Predict business opportunity
- Design the prototype
- Gain knowledge on system implications.

MA6201 LINEAR ALGEBRA	L	T	P	EL	TOTAL	CREDITS
	3	1	0	3		5

OBJECTIVES:

- To learn to analyze a linear system of equations
- To study the properties of a linear transformation
- To understand the process of orthogonalization
- To learn to solve linear equations using different methods
- To understand the applications of linear algebra in engineering

MODULE I	L	T	P	EL
	5	1	-	3

Vector spaces – Subspaces – Linear combinations and linear system of equations

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II	L	T	P	EL
	5	1	-	3

Linear independence and Linear dependence – Basis and Dimension

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III	L	T	P	EL
	5	1	-	3

Linear Transformation – Null space, Range space - Dimension theorem - Matrix representations of Linear Transformations

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV	L	T	P	EL
	5	1	-	3

Eigenvalues and Eigenvectors of a linear transformation – Diagonalization of linear transformations – Application of diagonalization in a linear system of differential equations

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE V	**L**	**T**	**P**	**EL**
	6	**2**	**-**	**6**

Inner Product Spaces –Norms - Orthogonal vectors – Gram Schmidt orthogonalization process - Least Square Approximations

SUGGESTED ACTIVITIES :

- Problem solving sessions

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VI	**L**	**T**	**P**	**EL**
	3	**1**	**-**	**3**

Solution of linear system of equations – Direct method: Gauss elimination method – Pivoting – Gauss Jordan method -LU decomposition method – Cholesky decomposition method

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VII	**L**	**T**	**P**	**EL**
	3	**1**	**-**	**3**

Iterative methods: Gauss-Jacobi and Gauss-Seidel – SOR Method

SUGGESTED ACTIVITIES :

- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII	**L**	**T**	**P**	**EL**
	3	**1**	**-**	**3**

Eigenvalue Problems: Power method – Inverse Power method - Jacobi's rotation method

- **SUGGESTED ACTIVITIES :**
- Problem solving sessions
- Applications in real life problems

SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				
MODULE IX GENERALISED INVERSES	**L**	**T**	**P**	**EL**
	3	**1**	**-**	**3**
QR decomposition - Singular Value Decomposition method				
SUGGESTED ACTIVITIES : • Problem solving sessions • Applications in real life problems				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

OUTCOMES:

Upon completion of the course, the students will be able to

- Perform linear transformations and write down the matrix representing a linear transformation
- Find the Gram-Schmidt orthogonalization of a matrix
- Determine the rank, determinant, eigenvalues and eigenvectors, diagonalization, and different factorizations of a matrix
- Solve a linear system of equations using direct and iterative methods
- Solve Eigen value problems
- Formulate linear equations for real life problems and solve them

TEXT BOOKS:

1. Stephen H. Friedberg, Insel A.J. and Spence L.E., "Linear Algebra", 4th. Edition, Prentice - Hall of India, New Delhi, 2003.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Limited, New Delhi, 2003.
3. Richard Bronson, "Matrix Operations", Schaum's Outline Series, 1989.

REFERENCES:

1. Strang G., "Linear Algebra and its Applications", Thomson (Brooks/Cole), New Delhi, 2005.
2. Kumaresan. S., "Linear Algebra – A Geometric Approach", PHI, New Delhi, 2010.
3. Faires J.D. and Burden R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 2002.
4. Gerald C.F., Wheatly P.O., "Applied Numerical Analysis", Pearson Education India, New Delhi, 2002.

EVALUATION METHOD TO BE USED:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓	✓							✓

CS6201	**GRAPH THEORY**	**L**	**T**	**P**	**EL**	**CREDITS**
		3	**1**	**0**	**3**	**5**

Prerequisites for the course: Discrete Mathematics

OBJECTIVES:

- To understand the fundamentals of graph theory
- To study the proofs related to various concepts in graphs
- To study about the different types of graphs and their properties
- To learn about the distinguishing features of various graph algorithms
- To study the applications of graphs in solving engineering problems

MODULE I	**INTRODUCTION**	**L**	**T**	**P**	**EL**
		4	**1**	**0**	**3**

Introduction - Graph Terminologies - Types of Graphs - Isomorphism - Isomorphic Graphs - Operations on graphs - Degree sequences - Euler graph - Hamiltonian Graph - Related theorems.

SUGGESTED ACTIVITIES :

- EL: Graphs and tournaments, Graphs in real world applications

SUGGESTED EVALUATION METHODS:

- Assignment on graphs in real world applications

MODULE II	**EDGE GRAPH**	**L**	**T**	**P**	**EL**
		3	**1**	**0**	**3**

Edge Graphs and Traversability - Eccentricity Sequences and Sets – Isometry.

SUGGESTED ACTIVITIES :

- Graph Isometry Problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Quizzes

MODULE III	**TREES**	**L**	**T**	**P**	**EL**
		3	**1**	**0**	**3**

Trees -Properties- Distance and Centres - Types - Rooted and Binary Tree- Tree Enumeration- Labeled Tree - Unlabeled Tree

SUGGESTED ACTIVITIES :

- EL: Binary trees and signed trees

SUGGESTED EVALUATION METHODS:

- Tutorial problems and assignment problems on generating trees with specified properties

MODULE IV SPANNING TREE	L	T	P	EL
	4	1	0	3

Spanning Tree - Fundamental Circuits- Cut Sets - Properties - Connectivity- Separability – Network Flows - 1-isomorphism, 2-isomorphism - Related Theorems

SUGGESTED ACTIVITIES :

- Concept maps to relate spanning trees with other topics

SUGGESTED EVALUATION METHODS:

- Tutorial problems on proof techniques
- Assignment problems on graph connectivity

MODULE V PLANARITY	L	T	P	EL
	3	2	0	3

Planar Graph - Representation - Detection of planarity - Dual Graph - Related Theorems.

SUGGESTED ACTIVITIES :

- Identification of planar and non-planar graphs

SUGGESTED EVALUATION METHODS:

- Tutorial problems on proving related theorems

MODULE VI DIGRAPH	L	T	P	EL
	3	1	0	3

Digraph - Properties - Euler Digraph – Tournament graph - Applications.

SUGGESTED ACTIVITIES :

- EL: Application of Digraph

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE VII GRAPH REPRESENTATION	L	T	P	EL
	3	1	0	3

Matrix Representation- Adjacency matrix- Incidence matrix- Circuit matrix - Cut-set matrix - Path Matrix- Properties - Related Theorems - Correlations.

SUGGESTED ACTIVITIES :

- Graph representation for different types of graphs

SUGGESTED EVALUATION METHODS:

- Tutorial problems on comparative analysis on representation methods
- Assignment problems

MODULE VIII COLORING AND COVERING	**L**	**T**	**P**	**EL**
	4	**2**	**0**	**3**

Graph Coloring - Chromatic Polynomial - Chromatic Partitioning - Matching - Covering - Related Theorems

SUGGESTED ACTIVITIES :

- EL: Edge coloring and example problems

SUGGESTED EVALUATION METHODS:

- Tutorial problems to find chromatic number of special graphs
- Assignment problems on applications using matching and covering

MODULE IX GRAPH ALGORITHMS -1	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Graph Algorithms- Connectedness and Components- Spanning Tree - Fundamental Circuits – Cut Vertices.

SUGGESTED ACTIVITIES :

- Programming on related algorithms

SUGGESTED EVALUATION METHODS:

- Demo on the programs for small applications

MODULE X GRAPH ALGORITHMS -2	**L**	**T**	**P**	**EL**
	4	**0**	**0**	**3**

Directed Circuits- Shortest Path – Planarity Testing – Isomorphism – Any two applications overview.

SUGGESTED ACTIVITIES :

- Project based learning to apply suitable concepts for a small application

SUGGESTED EVALUATION METHODS:

- Mini Project demo and evaluation

OUTCOMES:

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

- Point out the basic concepts of graphs, and different types of graphs
- Discuss the properties, theorems and be able to prove theorems
- Apply suitable graph models and algorithms for solving engineering problems
- Analyse various representations of graphs
- Analyse graph algorithms and discuss their suitability for applications

TEXT BOOKS:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall of India Pvt. Ltd, 2003.
2. S. Pirzada, “An Introduction to Graph theory”, University Press, 2012.

REFERENCES:

1. Frank Harary, “Graph Theory”, Narosa Publishing House, 2001.
2. West D. B., “Introduction to Graph Theory”, 2nd Edition, Pearson Education, 2001.
3. Diestel R, "Graph Theory", 5th Edition, Springer, 2017.

EVALUATION METHOD TO BE USED:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓			
CO2	✓	✓	✓					✓				✓
CO3	✓	✓	✓		✓			✓				✓
CO4	✓	✓	✓						✓		✓	
CO5	✓	✓	✓		✓					✓		

EC6201 SIGNALS AND SYSTEMS

OBJECTIVES:

- To understand the types of signals and systems
- To gain knowledge about understanding continuous time and discrete time signals.
- To learn time domain and frequency domain analysis of signals
- To learn the transformations from time domain to frequency domain
- To gain knowledge about the various functionalities available in signal processing software to support signal processing applications

SIGNALS AND SYSTEMS	L	T	P	EL	TOTAL CREDITS
	3	0	4	3	6

MODULE I :	L	T	P	EL
	3	0	4	3
Classification of Signals - Useful Signal models – periodic and a periodic signals, random signals, Energy & Power signals -Systems – Classification of systems				

SUGGESTED ACTIVITIES :

- In Class activity – expressing signals as a function of step, ramp.
- Practical – Plotting of Continuous signals and operations on them using either Open CV, MATLAB, OCTAVE
- EL – Study of any one Open CV, MATLAB, OCTAVE

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Time Domain analysis of continuous-time systems – unit impulse response – Convolution Integral – System response

SUGGESTED ACTIVITIES :

- EL – Visualizing signals of practical day to day activities like traffic light, count of vehicles, temperature of the day, stock market changes
- Practical - Implementation of continuous signals and understanding

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE III	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Fourier Series – Periodic representation by trigonometric Fourier series – Role of amplitude and phase spectra - LTI continuous system response to periodic inputs – Signals as vectors

SUGGESTED ACTIVITIES :

- EL – Flipped Class-room – Signal representation by orthogonal signal set
- Practical – Fourier series application using Open CV, MATLAB or OCTAVE

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE IV	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Fourier Transform – Aperiodic representation by Fourier integral – Properties of Fourier transform – Fourier transform in the analysis of Continuous time systems

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL – Application of Fourier transform
- Practical –Properties of Fourier transform implementation using Open CV, MATLAB, or OCTAVE

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE V	L	T	P	EL
	3	0	4	3

Classification of Discrete time systems – Sampling theorem – signal reconstruction – Discrete-time signal models

SUGGESTED ACTIVITIES :

- EL – Signal operations
- Practical - Open CV, MATLAB, or OCTAVE – implementation and visualization of discrete time systems

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE VI	L	T	P	EL
	3	0	4	3

Impulse response – Convolution sum – Discrete time systems response – Differential equation – Block diagram representation of Discrete time systems

SUGGESTED ACTIVITIES :

- EL – Impulse response for special cases, Correlation
- Practical –Convolution Implementation using MATLAB, OCTAVE or Open CV

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE VII	L	T	P	EL
	3	0	4	3

Z-transform – Properties of Z-transform – Inverse Z-transform – Pole-Zero location

SUGGESTED ACTIVITIES :

- Practical –Implementation of Z-transform using Open CV, MATLAB, or OCTAVE
- EL – Bilateral Z-transform, Inverse Z-transform using alternate methods

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes
- Practical exercises demo

MODULE VIII	L	T	P	EL
	3	0	4	3
Discrete Time Fourier transform – Properties – Inverse Discrete Time Fourier Transform				
SUGGESTED ACTIVITIES : • EL – DTFS, relationship between DTFT and Z-transform • Practical – Implementation DFT, properties using MATLAB, OCTAVE or Open CV				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes • Practical exercises demo				

MODULE IX	L	T	P	EL
	3	0	4	3
Discrete Fourier Transform – Properties – Circular Convolution – Inverse Discrete Fourier transform				
SUGGESTED ACTIVITIES : • EL – DTFS, relationship between DTFT and Z-transform • Practical – Implementation DFT, properties using MATLAB, OCTAVE or Open CV				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes • Practical exercises demo				

MODULE X	L	T	P	EL
	3	0	4	3
Fast Fourier Transform –Divide and Conquer – Decimation in Time – Radix-2 algorithm - Complexity				
SUGGESTED ACTIVITIES : • EL – Radix – n implementation of Fast Fourier Transform • Practical – Analyzing the FFT of signals and their interpretation				
SUGGESTED EVALUATION METHODS: • Assignment problems • Practical exercises demo				

MODULE XI	L	T	P	EL
	3	0	4	3
Fast Fourier transform – Decimation in frequency – Radix-2 algorithm - Inverse DFT using one FFT technique				
SUGGESTED ACTIVITIES : • EL – Derivation of Radix-n FFT for DIF algorithms				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Quizzes				

OUTCOMES:

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

- Analyze and classify any given signal and system
- Propose appropriate time domain and frequency domain analysis for a signal to satisfy an application
- Suggest appropriate frequency transformation to convert an analog signal to a digital signal
- Convert any input data to a signal and analyse it mathematically
- Code and represent a signal and analyse using a signal processing software

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, Pearson Education, Second Edition, 2014.
2. B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford University Press, Second Edition, 2009.

REFERENCES:

1. M.J. Roberts, “Signals & Systems, Analysis using Transform Methods & MATLAB”, Tata McGraw Hill (India), Third Edition, 2019.
2. P. Ramakrishna Rao, “Signals and Systems”, Second Edition, Tata McGraw Hill Publications, 2017.
3. H P Hsu, “Signals and Systems”, Schaum‘s Outline Series, Third Edition, Tata McGraw Hill, 2013.
4. S. Haykin and B. Van Veen, "Signals and Systems", Second Edition, Wiley, 2007.
5. Edward W. Kamen and Bonnie S. Heck, “Fundamentals of Signals and Systems Using the Web and MATLAB”, Pearson, Third Edition, 2006.
6. John Alan Stuller, “An Introduction to Signals and Systems”, Cengage Learning, 2007

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓							
CO2	✓	✓	✓	✓	✓	✓	✓					
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓	✓	✓		✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓				

CS6202 THEORY OF COMPUTATION	L	T	P	EL	CREDITS
	3	1	0	3	5

OBJECTIVES:

- To understand the Chomsky language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design CFG for any given language and prove its equivalence
- To understand the need for Turing machines and their capability
- To understand undecidable problems

MODULE I :	L	T	P	EL
	3	1	0	3

Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon Transitions – NFA to DFA conversion – Epsilon NFA to DFA conversion

SUGGESTED ACTIVITIES :

- Defining automata for different types of patterns
- EL – Epsilon NFA to DFA direct conversion

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	1	0	3

Regular Expression – FA and Regular Expressions – Pumping Lemma for Regular Languages

SUGGESTED ACTIVITIES :

- Proofs in class
- EL – Regular expression for practical patterns

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	1	0	3

Properties of Regular languages - Equivalence and Minimization of Automata

SUGGESTED ACTIVITIES :

- Flipped Class room – Moore and Mealy machines
- Problems based on properties – in-class and EL

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	2	1	0	3
Context-Free Grammar (CFG) – Derivation Trees – Ambiguity in Grammars and Languages – Equivalence of Parse Trees and Derivation				
SUGGESTED ACTIVITIES : • EL - CFG for practical programming constructs • EL – Alternate theorems and proofs				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE V :	L	T	P	EL
	4	1	0	3
Simplification of Context-free Grammar – Chomsky Normal Form – Greibach Normal Form				
SUGGESTED ACTIVITIES : • EL – Problems based on context-free grammar • Proofs of all the grammar equivalence – in-class				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE VI:	L	T	P	EL
	6	2	0	6
Definition of the Pushdown Automata – Language of a Pushdown Automata – Equivalence of Acceptance by Empty-stack and final state - Equivalence of Pushdown Automata and CFG – Pumping Lemma for CFL – Ogden's lemma for CFL - Closure Properties - Deterministic Pushdown Automata.				
SUGGESTED ACTIVITIES : • Proofs – in-class • EL – String acceptance using the converted PDA from CFG and CFG from PDA • EL - Problems based on properties of CFL				
SUGGESTED EVALUATION METHODS: • Tutorial problems • Assignment problems • Quizzes				

MODULE VII:	L	T	P	EL
	3	1	0	3
Turing Machines – Language of a Turing Machine – Turing Machine as a Computing Device				
SUGGESTED ACTIVITIES : • EL – problems on Turing machines as language acceptors, computing device • In-class and EL – Turing machines as computing functions in both unary and binary representation				

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Techniques for TM – Modifications of Turing Machines – Two-way Infinite Tape, Equivalence of One Way Infinite Tape and Two-way Infinite Tape Turing Machines – Multi Tape Turing Machines

SUGGESTED ACTIVITIES :

- Flipped Class room – Non-deterministic Turing machines, multi-dimensional Turing machine

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE IX:	**L**	**T**	**P**	**EL**
	6	**1**	**0**	**6**

Chomsky hierarchy - A Language that is not Recursively Enumerable (RE) – An Undecidable Problem that is RE – Undecidable Problems about Turing Machine – Universal language – L_r, L_{nr}, L_e, L_{ne}, - Rice Theorem for Recursive and Recursively Enumerable Languages

SUGGESTED ACTIVITIES :

- EL – Halting problem and other undecidable problems and their proofs

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE X:	**L**	**T**	**P**	**EL**
	3	**1**	**0**	**3**

Undecidable nature of Post Correspondence Problem and Modified Post Correspondence problem

SUGGESTED ACTIVITIES :

- EL – Problems based on PCP, MPCP and conversions
-

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

OUTCOMES:

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

- Classify languages based on Chomsky hierarchy
- Identify the class of language and design automata or Type x grammar
- Prove equivalence of the different language representations within a class of the Chomsky hierarchy
- Identify the undecidable problems and their class of languages
- Apply and prove a given language is decidable or undecidable

TEXT BOOK:

1. John E Hopcroft and Jeffery D Ullman, “Introduction to Automata Theory, Languages and Computations”, Narosa Publishing House, 2002.

REFERENCES:

1. J. Martin, “Introduction to Languages and the Theory of Computation”, Third Edition, Tata McGraw Hill, 2003.
2. Micheal Sipser, “Introduction of the Theory and Computation”, Thomson Brokecole, 1997.
3. H.R. Lewis and C.H. Papadimitriou, “Elements of the Theory of Computation”, Second Edition, Pearson Education, 2003.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓									✓		
CO2		✓	✓								✓	
CO3											✓	✓
CO4					✓				✓	✓		
CO5	✓									✓		✓

CS 6301 **MACHINE LEARNING**

OBJECTIVES:

- To understand the need for machine learning for various types of problem solving
- To know the mathematics involved in various machine learning algorithms
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn about probabilistic models in machine learning
- To have a glimpse of the latest developments in machine learning

CS 6301 MACHINE LEARNING	L	T	P	EL	TOTAL CREDITS
	3	0	4	3	6

MODULE I :	L	T	P	EL
	6	0	4	3

Learning – Types of Machine Learning – Supervised Learning - The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning- Concept Learning task – Concept Learning as Search - Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm

SUGGESTED ACTIVITIES :

- EL – Fundamentals of Predictive Analytics, Study of tools for data mining like WEKA, KNIME, Rapidminer, etc
- Practical – Study of tools like WEKA, KNIME and the UCI repository datasets

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	4	3

Neural Networks – Perceptron – Linear Separability – Linear Regression

SUGGESTED ACTIVITIES :

- In-class activity – practical problems and the need for machine learning algorithms
- EL – Working with tools and standard data sets
- Practical - Implementation of the Candidate Elimination Algorithm

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE III :	L	T	P	EL
	3	0	4	3

The Multi-Layer Perceptron – Back Propagation of Error-Multi-layer Perceptron in Practice – Deriving Back Propagation – Applications of MLP

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Applications of MLP
- Practical – Implementation of the Neural Network perceptron algorithm and enhancing it to other variations
- Proposal for Mini Project

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Approval of Mini project based on the reference papers, abstract and design

MODULE IV :	L	T	P	EL
	3	0	4	3

Radial Basis Function Network - Concepts –Training - Interpolation and Basis Functions – Solutions using RBF

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL –Applications of RBF Networks
- Practical – Implementation of Multi-layer Perceptron

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE V :	L	T	P	EL
	3	0	4	3

Dimensionality Reduction –Linear Discriminant Analysis-Principal Component Analysis-Factor Analysis-Independent Component Analysis-Locally Linear Embedding-Isomap

SUGGESTED ACTIVITIES :

- EL – Probabilistic PCA and Factor analysis concepts
- Practical –Implementation of Independent Component Analysis(ICA) algorithm
- Practical – Mini-project design completion

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE VI:	L	T	P	EL
	6	0	4	3

Probabilistic Learning-Gaussian Mixture Models-Nearest Neighbor Models-Support Vector Machines-Optimal Separation-Kernels-The Support Vector Machine Algorithm-Extensions to the SVM

SUGGESTED ACTIVITIES :

- EL – Application of SVM, Nearest Neighbor concepts and other regression models on various datasets
- Practical –Implementation of Support Vector Machines with various kernel models, Nearest Neighbor models
- Continuation of mini project, minimum 40% implementation

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstration of algorithms and mini project

MODULE VII:	L	T	P	EL
	3	0	4	3

Evolutionary Learning-The Genetic Algorithm-Genetic Operators-Using Genetic Algorithms-Genetic Programming - Applications

SUGGESTED ACTIVITIES :

- Flipped Classroom for applications
- EL – Applications of Evolutionary algorithms
- Practical – Implementation of GA, Continuation of mini-project

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE VIII	L	T	P	EL
	3	0	4	3

Reinforcement Learning – Markov Decision Processes - Values-The difference between SARSA and Q-Learning

SUGGESTED ACTIVITIES :

- Flipped Classroom for applications
- EL – Applications of Evolutionary algorithms
- Practical – Continuation of mini-project

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE IX	L	T	P	EL
	3	0	4	3

Learning with Trees-Using Decision trees-Constructing Decision Trees-Classification and regression trees-Classification example-Decision by committee: Ensemble Learning-Boosting-Bagging-Random Forests-Different ways to combine classifiers

SUGGESTED ACTIVITIES :

- EL – Applications of Decision tree, CART
- Practical –Implementation of Decision Trees, Bagging, Boosting and EM algorithms Continuation of mini-project

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations, Mini project 80% completion

MODULE X	L	T	P	EL
	3	0	4	3

Unsupervised Learning-The K-Means Algorithm-Vector Quantization-The self-organizing feature map

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- EL –K-Means algorithm applications
- Practical - Implementations of K-Means algorithm

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems

● Practical demonstrations				
MODULE XI	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Deep learning introduction – CNN – RNN				
SUGGESTED ACTIVITIES : ● EL – Survey of deep learning network models ● Practical – Mini-project demonstration				
SUGGESTED EVALUATION METHODS: ● Mini project final evaluation				

OUTCOMES:

Upon completion of the course, the students will be able to

- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Choose and implement classification or regression algorithms for an application using an open source tool
- Implement probabilistic, discriminative and generative algorithms for an application and analyze the results
- Use a tool to implement typical clustering algorithms for different types of applications
- Create potential solutions for real time applications using machine learning techniques

TEXT BOOKS

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.

REFERENCES:

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014.
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.

EVALUATION METHOD:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓	✓	✓				✓		✓	✓

CS6302 PROGRAMMING PARADIGMS

Prerequisites for the course: Data Structures and Algorithms

OBJECTIVES:

- To introduce the major programming paradigms with the principles and the techniques involved in the design and implementation of modern programming languages
- To introduce the framework for specifying and reasoning about programming languages
- To analyse a given program from the perspective of good programming practices
- To compare and contrast the range of programming paradigms
- To evaluate programming language features critically with respect to the way they support good software engineering practices
- To discuss the appropriateness of the use of a given programming paradigm within a given environment

CS6302 PROGRAMMING PARADIGMS	L	T	P	EL	CREDITS
	3	0	0	3	4

OBJECTIVES:

MODULE I :	L	T	P	EL
	3	0	0	5

The art of Language design – Programming language spectrum - Compilation and Interpretation– Evaluation of Programming languages

SUGGESTED ACTIVITIES :

- Activity based learning - brain storming quizzes and puzzles of programming languages

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE II :	L	T	P	EL
Languages – Syntax and Semantics of language C-lite - Names – Types – Type Systems - Binding – Scope – Static – Dynamic – Abstract Data types	4	0	0	5

SUGGESTED ACTIVITIES :

- Using peer learning- Interaction and group discussion about data types

SUGGESTED EVALUATION METHODS:

- Quizzes
- Assignment problems

MODULE III :	**L**	**T**	**P**	**EL**
Expression – Assignment - Control flow – Input/output – exception handling - exception hierarchy-throwing and catching exception	**4**	**0**	**0**	**5**

SUGGESTED ACTIVITIES :

- Problem based learning for solving problems using various exception handling techniques in the module.

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV :	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**6**
Introduction to semantics -state transformation – partial functions – semantics with dynamic typing – Formal treatment of semantics				

SUGGESTED ACTIVITIES :

- Outcome based learning- various assessment tests for the above four modules.

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE V :	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**6**
Functions - Call and Return – Parameter passing – function declaration – semantics of call and return				

SUGGESTED ACTIVITIES :

Activity based learning - quizzes and puzzles related to using functions

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**5**

Formal treatment of types and semantics – memory management – dynamic arrays – garbage collection

SUGGESTED ACTIVITIES :

- Problem based learning - Solving problems using dynamic arrays

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE VII	**L**	**T**	**P**	**EL**
	4	**0**	**0**	**5**

Programming techniques-Imperative programming – C – ADA – Perl

SUGGESTED ACTIVITIES :

- Based on project learning, develop a mini project based on C or Perl

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE VIII	**L**	**T**	**P**	**EL**
	4	**0**	**0**	**5**

Object Oriented Programming -grouping of data and operations-constructs for program structuring-information hiding-program design with modules - Object Oriented Programming – Small Talk-Java– Python

SUGGESTED ACTIVITIES :

- Case study to understand OOPs concepts of Java and Python

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE IX	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**5**

Functional Programming – Introduction to Scheme and Haskell- Expressions-types and functions

SUGGESTED ACTIVITIES :

- Problem solving paradigms in Functional programming

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE X	L	T	P	EL
	4	0	0	5
Logic programming – Prolog – Event-Driven programming – Concurrent Programming – Concepts – Synchronization strategies – Language level mechanism - Interprocess communication – Scripting languages.				
SUGGESTED ACTIVITIES : • Project based learning to apply suitable concepts for a small application.				
SUGGESTED EVALUATION METHODS: • Mini Project evaluation				

TEXT BOOKS:

1. Michael L Scott, "Programming Language Pragmatics", Third Edition, Morgan Kauffman, 2009.
2. Allen B. Tucker and Robert E. Noonan, "Programming Languages - Principles and Paradigms", Second Edition, Tata McGraw Hill, 2009.

REFERENCES

1. Daniel P. Friedman and Mitchell Wand, "Essentials of Programming Languages", Third Edition, The MIT Press, 2008.
2. Robert W. Sebesta, "Concepts of Programming Languages", Sixth Edition, Addison Wesley, 2003.
3. Terrence W. Pratt, Marvin V. Zelkowitz, "Programming Languages: Design and Implementation ", 4th Edition, Pearson, 2000.

OUTCOMES:

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

- Write programs related to syntax and semantics
- Compare programs between C, Perl and Small Talk
- Write programs using scripting languages
- Demonstrate event-driven and concurrent programming using Prolog
- Apply Prolog for developing distributed systems

EVALUATION METHOD:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓	✓	✓				✓		✓	✓

CS6303 DISTRIBUTED SYSTEMS	L	T	P	EL	CREDITS
	3	0	0	3	4

Prerequisites for the course: NONE

OBJECTIVES:

- To understand the foundations of distributed systems
- To learn issues related to clock Synchronization and the need for global state in distributed systems
- To learn distributed mutual exclusion and deadlock detection algorithms
- To understand the significance of agreement, fault tolerance and recovery protocols in distributed systems
- To learn the characteristics of peer-to-peer and distributed shared memory systems

.

MODULE I INTRODUCTION	L	T	P	EL
	4	0	0	3

Definition –Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Synchronous versus asynchronous executions –Design issues and challenges.

SUGGESTED ACTIVITIES :

- EL – Fundamentals of Distributed Systems
- Flipped classroom and activity

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE II A MODEL OF DISTRIBUTED COMPUTATIONS AND LOGICAL TIME	L	T	P	EL
	6	0	0	3

A distributed program –A model of distributed executions –Models of communication networks –Global state –Cuts –Past and future cones of an event –Models of process communications –A framework for a system of logical clocks –Scalar time –Vector time –Physical clock synchronization: NTP.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Basics of Communication Networks

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE III MESSAGE ORDERING AND GROUP COMMUNICATION	L	T	P	EL
	5	0	0	3

Message ordering paradigms –Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system –Group communication – Causal order (CO) - Total order.

SUGGESTED ACTIVITIES :

- EL- Basic concepts on Group Communication
- In class Activity on Message Ordering

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV GLOBAL STATE AND SNAPSHOT RECORDING ALGORITHMS	L	T	P	EL
	4	0	0	3

Introduction –System model and definitions –Snapshot algorithms for FIFO channels
.

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL - Introduction to Snapshot Algorithm

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE V DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS	L	T	P	EL
	5	0	0	3

Introduction – Preliminaries – Lamport's algorithm – Ricart - Agrawala algorithm – Maekawa's algorithm – Suzuki–Kasami's broadcast algorithm.

SUGGESTED ACTIVITIES :

- EL – Introduction to Mutual Exclusion
- In class activity on problem solving in Distributed Mutual Exclusion Algorithms

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VI DEADLOCK DETECTION IN DISTRIBUTED SYSTEMS	L	T	P	EL
	4	0	0	3

Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification– Algorithms for the single resource model, the AND model and the OR model.

SUGGESTED ACTIVITIES :

- EL – Introduction to Deadlock Detection.
- Flipped classroom and activity

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VII	CHECKPOINTING AND ROLLBACK RECOVERY	L	T	P	EL
		5	0	0	3

Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery –Coordinated check pointing algorithm –Algorithm for asynchronous checkpointing and recovery.

SUGGESTED ACTIVITIES :

- Combinations of in Class & Flipped class rooms
- EL – Applications for Rollback Recovery

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VIII	CONSENSUS AND AGREEMENT ALGORITHMS	L	T	P	EL
		4	0	0	3

Problem definition – Overview of results – Agreement in a failure –free system – Agreement in synchronous systems with failures.

SUGGESTED ACTIVITIES :

- Flipped classroom
- EL – Basics concepts of Agreement Algorithms
-

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IX	PEER-TO-PEER COMPUTING AND OVERLAY GRAPHS	L	T	P	EL
		4	0	0	3

Introduction – Data indexing and overlays –Chord – Content addressable networks –Tapestry.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Introduction to peer to peer computing

MODULE X	DISTRIBUTED SHARED MEMORY	L	T	P	EL
		4	0	0	3

Abstraction and advantages – Memory consistency models –Shared memory Mutual Exclusion.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Introduction to Memory Consistency Models

OUTCOMES:

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

- Elucidate the foundations and issues of distributed systems
- Point out the various synchronization issues and global state for distributed systems
- Demonstrate the mutual exclusion and deadlock detection in distributed systems
- Demonstrate the agreement protocols and fault tolerance mechanisms in distributed systems
- Describe the features of peer-to-peer and distributed shared memory systems

TEXT BOOK:

1. Ajay D. Kshemkalyani and Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2011.

REFERENCES:

1. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems, McGraw Hill, 2001.
4. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
5. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.
6. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufmann Publishers, USA, 2003.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓					✓	✓		✓
CO2	✓	✓		✓					✓	✓		✓
CO3	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO5	✓			✓					✓	✓		✓

CS6304 SOFTWARE ENGINEERING	L	T	P	EL	TOTAL CREDITS
	3	0	0	3	4

Prerequisites for the course: None

OBJECTIVES:

- To gain knowledge about various software development lifecycle (SDLC) models
- To appreciate the importance of requirements engineering in SDLC
- To be aware of designing a software, considering the various perspectives of the end user
- To learn to develop a software component using coding standards and facilitate code reuse
- To analyze the software using metrics and measurements and predict the complexity and the risk associated
- To appreciate appropriate software documentations across various SDLC stages

MODULE I:	L	T	P	EL
	4	0	0	3

Introduction –Product and Process –Software Development Lifecycle –Waterfall Model – Incremental Models – Evolutionary Models - Spiral Model – Unified model. Software Project Planning

SUGGESTED ACTIVITIES:

- In-class activity on Application specific Product and Process view
- External Learning on impact of unified process models on Quality Software Development and JIT software

SUGGESTED EVALUATION METHODS:

- Assignments: Selection of suitable software process models for a given software specification
- Tutorial problems: Identification of Sample Application for each process model and justify the same stating reasons.

MODULE II:	L	T	P	EL
	3	0	0	3

CMM – CMMI – PSP – TSP – ISO 12207 (Software Lifecycle), ISO 29148 (Requirements), ISO 15026 (Risk & Integrity), ISO 29119 (Testing), ISO 14764 (Maintenance), ISO 15939 (Measurement)

SUGGESTED ACTIVITIES:

- Need for organization wide standards adoption

SUGGESTED EVALUATION METHODS:

- Recalling the KPAs to be adhered for each level in CMM.
- Assignment on selection of appropriate standards for each phase in software development.

MODULE III:	L	T	P	EL
	3	0	0	3

Requirements Elicitation – Analysis & Negotiation – Requirements Modeling & Specification – Requirements Validation & Management

SUGGESTED ACTIVITIES:

- External Learning: Using open-source tools for RE to understand the requirements traceability and interdependency among the functionalities provided by the software project.

SUGGESTED EVALUATION METHODS:

- Tutorial on various Requirements elicitation mechanisms and selection of an appropriate strategy.

- Assignment on Requirements categorization (considering contradicting, omission, commission of requirements) in a software project

MODULE IV:	**L**	**T**	**P**	**EL**
	2	**0**	**0**	**3**

Data Modeling– Scenario Based Modeling

SUGGESTED ACTIVITIES:

- External Learning: Using open-source tools for Conceptual Data modeling of a Sample application
- External Learning: Using open-source tools for Scenario based modelling of a problem statement.

SUGGESTED EVALUATION METHODS:

- Assignment Data Modeling of sample application
- Assignment: Designing use case diagram and activity diagram to analyze the requirements obtained from the customer and segregate them as use cases and determine the possible set of activities from the end user.

MODULE V:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Flow Oriented Modeling – Class Based Modeling – User Interface Design

SUGGESTED ACTIVITIES:

- External Learning: Use open source tools to perform Class Based Modeling for a given software requirements.

SUGGESTED EVALUATION METHODS:

- Assignment: Determine the flow of data/events among the processes in the application under consideration
- Assignment: Designing UI of Sample application
- Assignment: Design-to-code of Sample application involving coding standards

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Testing strategies – Unit testing, Integration testing, OO testing – Smoke testing – Validation testing – System testing - Alpha/Beta testing – Recovery Testing – Security Testing – Stress Testing – Performance Testing

SUGGESTED ACTIVITIES:

- External Learning: Understanding the requirements (SRS) and designing a suitable test suite.
- External Learning: Determine valid interfaces for integration testing and design necessary stub and driver modules
- External Learning on ideas of testing a simple online application on selected test cases
- Tutorial on using Automation software for testing

SUGGESTED EVALUATION METHODS:

- Assignment on obtaining a mind-map on testing strategies
- Assignment: Testing of Sample application using any OSS on Software Test Automation

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Debugging Process - Testing Tactics – Black-box approaches – Graph based testing Methods – Equivalence class partitioning – Boundary value analysis – Orthogonal array testing

SUGGESTED ACTIVITIES:

- In-class activity on Equivalence class partitioning
- In-class activity on Boundary value analysis

- External Learning on Software Test Documentation

SUGGESTED EVALUATION METHODS:

- Assignment: Testing Sample application using Black-box approaches and understand the differences in selecting of test cases from the test suite.

MODULE VIII:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Testing Tactics – White-box approaches– Basis Path testing – Control Structure Testing

SUGGESTED ACTIVITIES:

- In-class activity on Basis Path testing
- In-class activity on Control-structure testing

SUGGESTED EVALUATION METHODS:

- Assignment: Testing Sample application for White-box approaches and understand how it differ from black box testing approaches.

MODULE IX:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Software Maintenance –Software Project Management - Software Cost Estimation - Risk Management& Mitigation – Configuration Management – Software Documentation standards

SUGGESTED ACTIVITIES:

- External Learning on using tools for estimating Software Cost

SUGGESTED EVALUATION METHODS:

- Tutorial: Identification of potential risks for a software project during development/ maintenance and tabulate.
- Assignment: Using a Software Configuration Management template for a software project

MODULE X:	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

Software Metrics – Process, Project and Product Metrics – OO Metrics - Test Metrics: Test effort, effectiveness, efficiency metrics – Test coverage, Test execution & Defect Distribution Metrics

SUGGESTED ACTIVITIES:

- External Learning on Software Quality Models
- In-class activity on FP metrics & Variants
- External Learning on Software Test Lifecycle

SUGGESTED EVALUATION METHODS:

- Assignment: Calculation of test metrics for sample application

OUTCOMES:

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

- Point out the role and impact of software engineering in contemporary business, and global, economic, environmental and societal context
- Analyze and resolve information technology problems through the application of systematic approaches and diagnostic tools

- Analyze, design and manage the development of a computing-based system, component or process to meet the desired needs within realistic constraints in one or more application domains
- Use knowledge, techniques, skills and modern tools necessary for software engineering practice
- Engineer tools to analyze, evaluate, select and synthesize information sources for the purpose of developing a software system

TEXTBOOKS:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill, Seventh Edition, 2009.
2. Ian Sommerville, "Software Engineering", Ninth Edition, Pearson Education, 2008.

REFERENCES:

1. Jalote Pankaj, "An Integrated Approach to Software Engineering", Third Edition, Springer, 2010.
2. Shari Lawrence Pfleeger and Joanne M. Atlee, "Software Engineering: Theory and Practice", Fourth Edition, Prentice Hall, 2010.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓			✓							
CO3	✓	✓			✓		✓		✓	✓		✓
CO4	✓	✓									✓	
CO5	✓	✓	✓		✓							

CS6305	MICROPROCESSORS	L	T	P	EL	CREDITS
		3	-	4	3	6

Prerequisites: None

OBJECTIVES:

- To learn the architecture of the Intel 8086 microprocessor
- To familiarize with assembly language programming and learn to write programs in 8086 assembly
- To discuss the various multiprocessor configurations
- To understand the functionality and working of different peripheral chips and their interfacing to the processor
- To understand the architecture and the salient features of the x86 family of processors
- To familiarize with tools for program analysis and performance analysis

MODULE I :	L	T	P	EL
	3	-	8	3

Intel 8086 Microprocessors – Architecture – Internal operation - Instruction set – Assembler directives and operators – Addressing modes

SUGGESTED ACTIVITIES :

- In Class activity for 8086 instructions and addressing modes
- EL - Familiarising with the assembler
- Practical – 8086 simple programs on the assembler.

SUGGESTED EVALUATION METHODS:

- Assignment problems on basic arithmetic operations
- Quizzes

MODULE II :	L	T	P	EL
	3	-	8	3

8086- Assembly language programming- Stacks - Procedures – Macros – Interrupts and Interrupt service routines – Byte and String manipulation instructions

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL – Study of BIOS calls for keyboard and video services
- Practical – 8086 programs using procedures, macros and string manipulation instructions
  - Use of BIOS calls for video and keyboard services

SUGGESTED EVALUATION METHODS:

- Assignment problems for using the various string primitives
- Quizzes

MODULE III :	L	T	P	EL
	3	-	4	3

8086 Signals – Basic Configurations – Minimum mode- Maximum mode – Queue status and Lock Facility - System Bus Timing

SUGGESTED ACTIVITIES :

- EL - Minimum mode signals, some timing diagrams
- Practical – To continue with 8086 assembly language programming.

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV :	**L**	**T**	**P**	**EL**
	3	**-**	**-**	**3**

System design using 8086: Multiprocessor configurations – Coprocessor – Closely coupled and Loosely coupled configurations

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL- Basics of Loosely Coupled Configurations

SUGGESTED EVALUATION METHODS:

- Assignment problems on different types of configurations
- Quizzes

MODULE V :	**L**	**T**	**P**	**EL**
	3	**-**	**4**	**3**

Memory interfacing and I/O interfacing – Parallel communication Interface – Programming and Applications.

SUGGESTED ACTIVITIES :

- EL – Applications using 8255
- Practical - Implementation of various modes of operations of 8255 and applications

SUGGESTED EVALUATION METHODS:

- Assignment problems on memory interfacing and I/O interfacing in different configurations, System design using the 8086
- Quizzes

MODULE VI:	**L**	**T**	**P**	**EL**
	3	**-**	**4**	**3**

Serial communication interface – Interrupt controller – DMA controller – programming and applications

SUGGESTED ACTIVITIES :

- EL – System design using these devices, Applications
- Practical - Implementation of various modes of operations of these devices

SUGGESTED EVALUATION METHODS:

- Assignment problems on applications and interfacing
- Quizzes

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**-**	**4**	**3**

IA 32 and IA 64 architectures - Evolution and salient features - Basic execution environment - System architecture overview - Modes of operation - Protected mode memory management.

SUGGESTED ACTIVITIES

- Flipped Classroom
- EL - evolution of the Intel processors
- Practical - Study of a typical program debugging tool
  - Create dis-assembly of a simple C program and identify the stack frame and its contents

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes
- Report on the execution trace

MODULE VIII:	L	T	P	EL
	6	-	4	3

Paging - Address translation - Protection - Paging MMU cache - Demand paging and virtual memory management - Using segmentation and paging together. Privilege levels - Protection - Defining and changing privilege levels.

SUGGESTED ACTIVITIES :

- Flipped classroom
- EL - Further explorations with the debugging tool
- Practical - Instrumentation and analysis with the tool

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes
- Report based on the additional features

MODULE IX:	L	T	P	EL
	6	-	4	3

Multitasking - Task state segments - Scheduling - Changing privilege levels within a task - Communicating among tasks, Handling faults and interrupts.

SUGGESTED ACTIVITIES :

- EL – Different types of exceptions and their handling
- Practical – Study of a performance analysis tool

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE X:	L	T	P	EL
	3	-	4	3

Performance issues - Power and thermal management - Performance monitoring.

SUGGESTED ACTIVITIES :

- Flipped Classroom
- Practical - Performance monitoring with the tool and reporting the various parameters like the number of instructions, cache misses, context switches, etc.

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes
- Report on the findings of the performance tool for various scenarios

OUTCOMES:

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

- Discuss the architecture of the 8086 processor in detail
- Write assembly language programs in 8086 assembly
- Show how multiple processors can be connected with an 8086 processor
- Show how the various peripheral chips can be interfaced to the processor
- Point out the salient features of the other processors in the x86 family and discuss the various modes of operation of these processors
- Generate CFGs for simple C programs using the dynamic instrumentation tools and generate performance statistics

TEXT BOOKS:

1. Yu – Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086/8088 Family – Architecture, Programming and Design ", Second Edition, Prentice Hall of India, 2007.
2. Barry B. Brey, "The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions : Architecture, Programming, and Interfacing", Eighth edition, Pearson Prentice Hall, 2009.

REFERENCES:

1. Peter Abel, "IBM PC Assembly Language and Programming",Fifth edition, Prentice Hall, 2000.
2. James L. Turley, "Advanced 80386 Programming Techniques", Osborne McGraw Hill, 1988.
3. Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3B: System Programming Guide, Part 2.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓	✓									
CO3	✓	✓	✓									
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓
CO6	✓	✓	✓		✓				✓			✓

CS6306 PARALLEL PROGRAMMING	L	T	P	EL	CREDITS
	3	0	4	3	6

Prerequisites for the course: NONE

OBJECTIVES:

- To identify the scope available for parallel programming over different models
- To identify the challenges in parallel programming
- To develop parallel programs using OpenMP in shared memory
- To develop parallel programs in distributed memory using MPI
- To program heterogeneous processors using CUDA and OPENCL

MODULE I :	L	T	P	EL
	3	0	0	3

Introduction to Parallel Computing –Need for Parallel Computing – Concurrent, Parallel and Distributed Systems – The Von Neumann Architecture – Flynn's Taxonomy

SUGGESTED ACTIVITIES :

- EL – Fundamentals of Parallel Computing.
- In Class activity for Conversion of Simple Serial Problem to Parallel Problem

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	4	3

Parallel Computing Models - ILP, TLP and Data Parallelism – Parallel Programming Overview: Processes, Tasks and Threads - Parallel Programming Models: Shared Memory Programming – Distributed Programming.

SUGGESTED ACTIVITIES :

- Flipped classroom and activity
- EL - Basics of Inter Process Communication (IPC)
- Practical - Programs on Interprocess Communication (Shared memory, Message Queue, Pipes)

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE III :	L	T	P	EL
	3	0	0	3

Interconnection Networks : Shared Memory Interconnects - Distributed Memory Interconnects – Parallel Software – Identifying Potential Parallelism – Techniques for Parallelizing Programs

SUGGESTED ACTIVITIES :

- EL – Basics of Interconnection Networks
- In class activity to identify techniques for parallelizing the program

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV :	L	T	P	EL
	3	0	4	3

Performance: Speedup and Efficiency – Amdahl's Law – Scalability – Parallel Program Design – Writing and Running Parallel Programs.

SUGGESTED ACTIVITIES :

- EL- Writing simple parallel programs
- In class activity for speed and efficiency calculation
- Practical - Analyzing and comparing the speedups on serial and parallel programs

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE V :	L	T	P	EL
	3	0	0	3

Challenges of Parallel Programming: Cache Coherence Issues - Memory Consistency Models – Maintaining Memory Consistency – Synchronization Issues.

SUGGESTED ACTIVITIES :

- Flipped Class room
- EL – Basics of cache principles

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VI:	L	T	P	EL
	6	0	8	3

Shared Memory Model: OpenMP Execution Model – Parallel regions – Work Sharing – Data Environment – Synchronization – Reductions – Data Parallelism – Functional Parallelism – Runtime Library Routines– Environment Variables–Performance Improvements.

SUGGESTED ACTIVITIES :

- EL – Introduction to OpenMP
- Practical - Programs on OpenMP and Applications on OpenMP

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VII:	L	T	P	EL
	3	0	4	3
The MPI Programming Model – MPI Basics – Circuit Satisfiability – Global Operations – Collective Operations.				
SUGGESTED ACTIVITIES : • EL – Introduction to MPI • Practical - Programs on MPI				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quizzes				

MODULE VIII:	L	T	P	EL
	3	0	4	3
Other MPI Features – Asynchronous Communication – Performance Issues – Combining OpenMP and MPI.				
SUGGESTED ACTIVITIES : • Combinations of in Class & Flipped class rooms • EL – Applications of OpenMP and MPI • Practical - Applications on MPI				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quizzes				

MODULE IX:	L	T	P	EL
	3	0	4	3
GPU Architecture – Basics of CUDA – CUDA Threads – CUDA Memories – Synchronization Handling – - Performance Issues - Application Development using CUDA.				
SUGGESTED ACTIVITIES : • Flipped classroom • EL – Basics of GPU and Applications of CUDA • Practical - Programs on CUDA				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quizzes				

MODULE X:	L	T	P	EL
	3	0	4	3
Introduction to OpenCL – Benefits of OpenCL- Anatomy of OpenCL – OpenCL Architecture – Application development using OpenCL				
SUGGESTED ACTIVITIES : • Mostly in Class • EL – Applications of OpenCL. • Practical - Programs on OpenCL.				

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Tutorial problems

OUTCOMES:

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

- Point out the fundamental concepts of parallelism
- Discuss the challenges in parallel programming
- Parallelize a serial program and point out the advantages and overheads
- Implement parallel programs with OpenMP and MPI
- Develop parallel programs in a heterogeneous processor using OpenCL and CUDA

TEXT BOOKS

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.
2. Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
3. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kaufmann, 2010.

REFERENCES:

1. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", Second Edition, Pearson Education Limited, 2003.
2. John L. Hennessy and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.
3. Ian Foster, "Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering", Addison Wesley Longman Publishing Co., USA, 1995.
4. David E. Culler, Jaswinder Pal Singh, Anoop Gupta, "Parallel Computing Architecture: A Hardware/Software Approach" , Morgan Kaufmann / Elsevier Publishers, 1999.
5. OpenMP Programmer's Manual.
6. MPI Programmer's Manual
7. "Introduction to OpenCL Programming", AMD, 2010.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓			✓						✓
CO2	✓	✓	✓	✓		✓				✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓			✓	✓		✓
CO4	✓	✓	✓	✓	✓				✓	✓		✓
CO5	✓	✓	✓	✓	✓				✓	✓		✓

CS6307 ADVANCED ALGORITHMS

Prerequisites for the course: Data Structures & Algorithms

OBJECTIVES:

- To familiarize with the main thrust areas in algorithms that will be sufficient for formulating and seeking known solutions to an algorithmic problem
- To understand how to formulate an approximation algorithm for an NP-complete problem
- To introduce the key concepts, problems, techniques and data structures within Computational Geometry
- To understand and analyze multithreading and parallel algorithms
- To learn linear programming models

CS6307 ADVANCED ALGORITHMS	L	T	P	EL	CREDITS
	3	0	4	3	6

MODULE I	L	T	P	EL
	3	0	8	3

PRAM Models–List Ranking - Prefix sum - Sorting - Sum - Bitonic sort.

SUGGESTED ACTIVITIES :

- EL - Study of one or two problems having parallel solutions
- Practicals – Implementation of list ranking, prefix sum and bitonic sort using C with MPI
- Analysis of suitable PRAM models

SUGGESTED EVALUATION METHODS:

- Assignment - Based on EL
- Demonstration of programs

MODULE II	L	T	P	EL
	4	0	4	3

Sorting on: Butterfly - 2D Mesh. Matrix multiplication on: 2D Mesh - Hypercube.

SUGGESTED ACTIVITIES :

- EL – Study atleast two problems on any of the DCM
- Practicals – Implementation of sorting and matrix multiplication on 2D mesh using C with MPI

SUGGESTED EVALUATION METHODS:

- Assignment - Based on EL
- Demonstration of programs

MODULE III	L	T	P	EL
	3	0	4	3

Prefix sum on: 2D Mesh - Butterfly. Sum on: 2D Mesh - Butterfly.

SUGGESTED ACTIVITIES :

- EL - Based on suggested reading by the course instructor
- Practical – Implementation of prefix sum and sum on 2D mesh using C with MPI

SUGGESTED EVALUATION METHODS:

- Assignment: Based on EL
- Quizzes: Based on first three modules
- Demonstration of programs

MODULE IV	**L**	**T**	**P**	**EL**
	6	**0**	**4**	**3**

Geometric Algorithms: Segment trees - kd-trees - 1D and 2D Range Search.

SUGGESTED ACTIVITIES :

- EL: Problems on segment trees and range search
- Practical – Implementation of segment trees

SUGGESTED EVALUATION METHODS:

- Based on EL
- Demonstration of programs

MODULE V	**L**	**T**	**P**	**EL**
	4	**0**	**4**	**3**

Line Segment Intersection - Closest Pair of Points - Range Trees – Voronoi diagram.

SUGGESTED ACTIVITIES :

- EL – Study of Voronoi diagram
- Practical – Implementation of line segment intersection and Voronoi diagram

SUGGESTED EVALUATION METHODS:

- Demonstration of programs

MODULE VI	**L**	**T**	**P**	**EL**
	5	**0**	**4**	**3**

Randomized Algorithms: Introduction - Randomized Selection - Randomized sorting.

SUGGESTED ACTIVITIES :

- Flipped Classroom – Types of Randomized Algorithms and analysis
- Practical – Implementation of randomized selection and quick sort

SUGGESTED EVALUATION METHODS:

- Quizzes: Based on Modules IV, V and VI
- Demonstration of programs

MODULE VII	**L**	**T**	**P**	**EL**
	5	**0**	**0**	**3**

Approximation Algorithms: Vertex cover - Metric TSP- Set Covering Problem

SUGGESTED ACTIVITIES :

- Assignment

SUGGESTED EVALUATION METHODS:

- Assignment problems

MODULE VIII	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**3**

NP Complete: Clique Problem - Subset Sum Problem

SUGGESTED ACTIVITIES :

- EL – Studying proof for atleast one NP complete problem

SUGGESTED EVALUATION METHODS:

- Based on EL

MODULE IX	L	T	P	EL
	3	0	4	3

Multithreaded Algorithms: Matrix Multiplication - Merge sort.

SUGGESTED ACTIVITIES :

- Quiz
- Practical – Implementation of multithreaded algorithms

SUGGESTED EVALUATION METHODS:

- Quizzes: Based on Modules VII, VIII and IX
- Demonstration of programs

MODULE X	L	T	P	EL
	3	0	4	3

Solving system of linear equations - Simplex algorithm – Duality.

SUGGESTED ACTIVITIES :

- Assignments
- Practical – Implementation of simplex algorithm

SUGGESTED EVALUATION METHODS:

- Assignments
- Demonstration of programs

OUTCOMES:

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

- Comprehend and propose algorithms for any given problem
- Construct and implement algorithms for simple geometrical problems
- Perform the design of parallel and multithreading algorithms
- Find approximate solution to a hard problem
- Formulate a linear programming model for a given problem

TEXTBOOKS:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, University Press, 2007.
2. Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Cliford Stein, “Introduction to Algorithms”, Third Edition, Prentice Hall, 2010.
3. Mark de Berg, Otfred Vheong, Marc van Kreveld and Mark Overmars, “Computational Geometry Algorithms and Applications”, Third Edition, Springer, 2008.

REFERENCES:

1. Gilles Brassard, Paul Bratley,” Algorithmics: Theory and Practice”, Prentice Hall,1998
2. J.A.Storer, “An Introduction to Data Structures and Algorithms”, Birkhauser Boston, 2002.
3. Michael Quinn, "Parallel Programming in C with MPI and OpenMP", Indian Edition, Tata McGraw Hill, 2017.

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory	**40**	**20**	**40**

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓				✓	✓	✓	✓

CS6308 JAVA PROGRAMMING

Pre-requisites: None

OBJECTIVES:

- To learn about the fundamentals of Java language constructs
- To familiarize the student with Object Oriented Programming in Java
- To expose the student to creating UI
- To understand the concepts of parallel programming
- To develop web applications with Java

CS6308 JAVA PROGRAMMING	L	T	P	EL	CREDITS
	3	0	4	3	6

MODULE I FUNDAMENTALS OF JAVA LANGUAGE	L	T	P	EL
	3	0	4	3

Introduction to Java, Java basics – Variables, Operators, Expressions, Control flow Statements, Methods, Arrays

SUGGESTED ACTIVITIES :

- Practical-Implementation of simple Java programs Using Java Basic Constructs and Arrays using any standard IDE like NETBEANS / ECLIPSE
- EL – Understanding JVM

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE II JAVA OBJECTS -1	L	T	P	EL
	3	0	4	3

Classes and Objects, Constructor, Destructor, Static instances, this, constants, Thinking in Objects, String class, Text I/O

SUGGESTED ACTIVITIES :

- Flipped classroom
- Practical - Implementation of Java programs – using String class, Creating Classes and objects
- EL – Thinking in Objects

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE III JAVA OBJECTS – 2	L	T	P	EL
	3	0	4	3

Inheritance and Polymorphism – Super classes and sub classes, overriding, object class and its methods, casting, instance of, Array list, Abstract Classes, Interfaces, Packages, Exception Handling

SUGGESTED ACTIVITIES :

- flipped classroom
- Practical - implementation of Java programs – use Inheritance, polymorphism, abstract classes and interfaces, creating user defined exceptions
- EL – dynamic binding, need for inheritance, polymorphism, abstract classes and interfaces

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IV GUI	L	T	P	EL
	3	0	4	3

Creating UI, Frames, layout manager, Panels, components, Event Driven Programming

SUGGESTED ACTIVITIES :

- flipped classroom
- Practical – Mouse, key events, creating interactive forms using AWT/Swing and adding functionality
- EL – Understand AWT and SWING

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE V I/O STREAMS	L	T	P	EL
	3	0	4	3

I/O Streams, binary I/O

SUGGESTED ACTIVITIES :

- Practical - binary streams, file streams
- EL – Lambdas and Streams

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VI MULTITHREADING	L	T	P	EL
	3	0	4	3

Multithreading – states, synchronization, avoiding deadlocks

SUGGESTED ACTIVITIES :

- Practical – implementing threads
- Flipped Classroom,
- EL – Parallel Programming

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VII NETWORKING AND DATABASE CONNECTIVITY	L	T	P	EL
	3	0	4	3

Java Networking – Inet address class, Sockets, JDBC

SUGGESTED ACTIVITIES :

- Flipped class room
- Practical – Using Socket, Developing simple applications using JDBC
- EL – Internationalization

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE VIII FRAMEWORKS	L	T	P	EL
	3	0	4	3

Collections Frameworks – lists, vector and stack classes, Generics,

SUGGESTED ACTIVITIES :

- Flipped classroom
- Practical - Using Generic classes and Collections framework, Using Comparative interface, list, stack
- EL - Code Annotations

SUGGESTED EVALUATION METHODS:

- Assignment problems
- Quizzes

MODULE IX WEB DEVELOPMENT - 1	L	T	P	EL
	3	0	4	3

Applets, Servlets / JSP

SUGGESTED ACTIVITIES : • Flipped class room • Practical - Implementations of Java programs – Creating applets, servlets, JSP • EL – Java based web servers				
SUGGESTED EVALUATION METHODS: • Assignment problems • Quizzes				
MODULE X WEB DEVELOPMENT - 2	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
JSF, RMI, Web services				
SUGGESTED ACTIVITIES : • Flipped class room • Practical - Implementations of Java programs – Creating UI with JSF, Implementing RMI • EL – creating UI with JSF				
SUGGESTED EVALUATION METHODS: • Quizzes				

OUTCOMES:

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

- Use NETBEANS or equivalent open source editors for Java programming
- Create and use Java Objects for applications related to object oriented concepts
- Demonstrate networked Java Applications using Java Sockets and JDBC
- Implement Multithreading and create rich UI
- Implement and deploy web applications using Java

TEXT BOOKS:

1. Y. Daniel Liang, “Introduction to Java Programming and Data Structures, Comprehensive Version”, 11th Edition, Pearson Education, 2018.
2. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw-Hill Education, 2018.

REFERENCES:

1. Paul Dietel and Harvey Deitel, “Java - How to Program Early Objects”, 11th Edition, Pearson Education, 2017.
2. Sachin Malhotra, Sourabh Choudhary, “Programming in Java”, Revised 2nd Edition, Oxford University Press, 2018.
3. Cay S. Horstmann, “Core Java - Vol. 1, Fundamentals”, 11th Edition, Pearson Education, 2018.

Web references:

1. NPTEL
2. MIT OCW

EVALUATION PATTERN:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester
Theory Integrated with Practical	15(T) + 25 (P)	20	40

CO - PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓				✓	✓		
CO2	✓	✓			✓				✓	✓		
CO3	✓	✓		✓	✓				✓	✓		
CO4	✓	✓		✓	✓				✓	✓		
CO5	✓	✓	✓	✓	✓				✓	✓		✓