SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)

SALEM - 16

Reaccredited with 'B++' Grade by NAAC

Affiliated to Periyar University



PG & RESEARCH DEPARTMENT OF MATHEMATICS

(DST-FIST & DBT-STAR SPONSORED)

Outcome Based Syllabus

B.Sc. MATHEMATICS

(For the students admitted in 2024-25 onwards)

B.Sc. MATHEMATICS

PROGRAMME OUTCOMES

- **PO1 Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.
- **PO2 Critical Thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
- **PO3 Problem Solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.
- **PO4** Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.
- **PO5** Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned perspective.
- **PO6** Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

B.Sc. MATHEMATICS

PROGRAMME SPECIFIC OUTCOMES

- **PSO1** Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.
- **PSO2** Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.
- **PSO3** To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16. PG & RESEARCH DEPARTMENT OF MATHEMATICS (DST-FIST & DBT-STAR SPONSORED) B.Sc. MATHEMATICS PROGRAMME STRUCTURE UNDER CBCS (For the students admitted in 2024-25 onwards) Total Credits: 140 + Extra Credits (Maximum 28)

Part	Course	Course Title Code		No. of Hours	Credits		
Ι	Language	Tamil-I / Hindi-I / Sanskrit-I	24ULTC1/ 24ULHC1/ 24ULSC1	6	3		
II	English	General English – I	24ULEC1	6	3		
	Core Course -I	Algebra & Trigonometry	24UMACC1	4	4		
III	Core Course -II	se -II Differential Calculus 24UMACC2		5	4		
-		Physics – I 24UMAGEC1		3	3		
	Generic Elective -I	Physics Practical – I	24UMAGECQ1	2	2		
IV	Skill Enhancement Course (NME-I)	Mathematics for Competitive Examinations	24UMASEC1	2	2		
	Skill Enhancement (Foundation Course)	Bridge Mathematics	24UMASEFC	2	2		
		Total		30	23		
V	 Articulation and Idea Fixation Skills Physical Fitness Practice - 35 Hours per Semester Advanced Diploma in Vedic Mathematics Level -1: Certificate Course 100 Hours per Year 						

I SEMESTER

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16. PG & RESEARCH DEPARTMENT OF MATHEMATICS (DST-FIST & DBT-STAR SPONSORED) B.Sc. MATHEMATICS PROGRAMME STRUCTURE UNDER CBCS (For the Academic Year 2024-25 onwards) Total Credits: 140 + Extra Credits (Maximum 28)

SEMESTER-II

Part	Course	Course Title	Code	No. of Hours	Credits
Ι	Language	Tamil-II / Hindi-II / Sanskrit-II	24ULTC2/ 24ULHC2/ 24ULSC2	6	3
II	English	General English – II	24ULEC2	6	3
	Core Course -III	Analytical Geometry (Two & Three Dimensions)	24UMACC3	5	4
III	Core Course -IV	Integral Calculus	24UMACC4	4	4
	Elective-II	hysics – II 24UMAGEC2		3	3
	(Generic)	Physics Practical – II	24UMAGECQ2	2	2
	Skill Enhancement Course -II(NME)	Quantitative Aptitude for Competitive Examinations	24UMASEC2	2	2
IV	Skill Enhancement Course- III (Indian Knowledge System)	History and Development of Indian Mathematics (From Vedic Period to Modern Era)	24UMASEC3	2	2
		Total		30	23
V	 Articulation Physical Fith Advanced D Level 1: Ce 	and Idea Fixation Skills-1 Extra ness Practice - 35 Hours per Ser Piploma in Vedic Mathematics	a Credit nester-1 Extra Credi	t	
	• Level -1: Ce Extra credits are giv	en for extra skills and courses c	qualified in MOOC/N	NPTEL	

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16. PG & RESEARCH DEPARTMENT OF MATHEMATICS (DST-FIST & DBT-STAR SPONSORED) B.Sc. MATHEMATICS PROGRAMME STRUCTURE UNDER CBCS (For the Academic Year 2024-25 onwards) Total Credits: 140 + Extra Credits (Maximum 28)

Part	Course	Course Title	Code	No. of Hours	Credits		
Ι	Language	Tamil-III / Hindi-III/ Sanskrit-III	24ULTC3 24ULHC3 24ULSC3	6	3		
II	English	General English – III	24ULEC3	6	3		
	Core Course -V	Vector Calculus and its Applications	24UMACC5	4	4		
III	Core Course -VI	Differential Equations and its Applications	24UMACC6	5	4		
	Elective-III (Discipline)	Mathematical Statistics-I	24UMADSEC1	5	5		
	Skill enhancement course	Statistics with Excel Programming- Practical (Entrepreneurial Skill)	24UMASECQ4	1	1		
IV	Skill Enhancement Course	Data Analytics with R- Practical	24UMASECQ5	2	2		
		Environmental Studies		1			
		Total	1	30	22		
v	 Articulation and Idea Fixation Skills Physical Fitness Practice - 35 Hours per Semester Advanced Diploma in Vedic Mathematics Level -2: Certificate Course 100 Hours per Year Extra credits are given for extra skills and courses qualified in MOOC/NPTEL 						

SEMESTER-III

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16. PG & RESEARCH DEPARTMENT OF MATHEMATICS (DST-FIST & DBT-STAR SPONSORED) B.Sc. MATHEMATICS PROGRAMME STRUCTURE UNDER CBCS (For the Academic Year 2024-25 onwards)

Total Credits: 140 + Extra Credits (Maximum 28)

SEMESTER-IV

Part	Course	Course Title	Code	No. of Hours	Credits
		Tamil-IV /	24ULTC4		
Ι	Language	Hindi-IV/	24ULHC4	6	3
		Sanskrit-IV	24ULSC4		
II	English	General English – IV	24ULEC4	6	3
	Core Course - VII	Industrial Statistics	24UMACC7	4	4
	Core Course - VIII	Elements of Mathematical Analysis	24UMACC8	4	4
III		Theory: Mathematical statistics-II (3 Credits)	24UMADSEC2		
	Elective-IV (Discipline)	Practical: Mathematical statistics using R Programming - Practical (2 Credits) 24UMADSECQ		5	5
IV	Skill enhancement course	Computational Mathematics with MALAB- Practical	24UMASECQ6	2	2
1.	Skill Enhancement Course	LaTeX- Practical	24UMASECQ7	2	2
		Environmental Studies		1	2
		Total	I	30	25
V	 Articulation at Physical Fitne Extra credits at Advanced Dire 	nd Idea Fixation Skills-1 Extr ss Practice - 35 Hours per Se re given for extra skills and c loma in Vedic Mathematics	a Credit mester-1 Extra Crec courses qualified in	lit MOOC/NI	PTEL
	Level -2: Dip	loma Course 100 Hours per Y	Year- 2 Credits		

Title of the Co	ourse	ALGEBRA & TRIGONOMETRY								
Paper Numbe	r	CORE I								
Category	CORE	Year		Ι	Cred	its	4	Cours	e	24UMACC1
		Semester		Ι				Code		
Instructional	Hours	Lecture	Tu	ıtoria	ıl	Lab	Prac	tice	To	tal
per week	3		1			-		4		
Pre-requisite	12 th Standard	Mat	thema	tics						
Objectives of	the	1.Basic ideas	on t	he Th	eory o	f Equ	ation	s, Matri	ces a	and Number Theory.
Course		2.Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.								ctions, solve
Students will CO1: Classif CO2: Find th CO3: Find Ei matrix CO4: Expand CO5: Determ trigono Course Outli	be able to y and solve e sum of gen value I the power ine relation metric se	ve reciprocal equ binomial, expon es, eigen vectors ers and multiple onship between ries Unit – I (Hours: Reciproc roots of a given of of polynomials b Chapter 4 (Se (Section 108) Unit –II (Hours Summati (Theorems with) Chapter 1 (Pag Unit–III (Hours Characte matrices - Cayle square matrix, In square matrices Chapter 5(Sect)	uation ention s of circ s of circ : 12 cal I equa by H ctio : 12 ion (out) : 12 ion (out) : 12 ion (out) : 12 ion (crc : 12) : 12 : 12: 12 : 12: 12 : 12	ons ial an erify C f trigo cular a) Equat ation Horne ons 3 c) of Se proof 4 - 88 2) ic eq Hami rse of lated s5.1 -	d logar Cayley nomet and hyj ions-S - Remo r's mer 2-34), ries: B) – Ap , 90 – 1 uation lton Th a squ proble 5.3) &	ithmid - Ham ric fur perbol tandar oval of thod – Chap inomi proxir IO3) & –Eige neorem are ma ms. Page	c seri nilton nctior lic fur of for f term - relat oter al - E natio $\frac{k}{2}$ Ch en va n (Sta atrix 371	es theorer is in terr nctions rm–Incr is, Appr ted prob 5 (Sect Exponen ns - rela apter 1: alues and atement up to or	n and ms o and t reasin oxin lems ion tial - ited p 3 (Pa only rder 1	d diagonalize a given f sine and cosine the summation of ng or decreasing the nate solutions of roots 3. 45) & Chapter 11 - Logarithmic series problems. age 253) igen Vectors-Similar) - Finding powers of 3, Diagonalization of

	Unit –IV (Hours: 12)
	Expansions of sin $n\theta$, cos $n\theta$ in powers of sin θ , cos θ - Expansion of
	tan n θ in terms of tan θ , Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$ –Expansions
	of $tan(\theta_1+\theta_2+,,+\theta_n)$ -Expansions of $sin\theta$, $cos\theta$ and $tan\theta$ in terms of θ - related
	problems.
	Chapters9 (Page 169 - 174) & Chapter 5 (Page 79 - 84)
	Unit –V (Hours: 12)
	Hyperbolic functions – Relation between circular and hyperbolic
	functions Inverse hyperbolic functions, Logarithm of complex quantities,
	Summation of trigonometric series - related problems.
	Chapter 4 (Page 52-57), Chapter 6 (Page 104 – $10/\&$ 110),
	Chapter 10 (Page 197-202),
	Chapter 13 (Page 241 - 245 & 256) & Chapter 9 (Page 174 - 178)
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part	examinations UPSC/TRB/NET/UGC - CSIR/ GATE/ TNPSC/ others to be
of Internal Component	solved.
only, not to be	
included in the	(To be discussed during the Tutorial hour)
External Examination	
question paper)	Knowledge Broklem Solving Analytical shility Professional Competency
from the course	Knowledge, Problem Solving, Anarytical ability, Professional Competency,
from the course	Professional Communication and Transferrable Skill
Recommended	1. W.S. Burnstine and A.W. Panton, Theory of equations (for Unit I)
Text	2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson
	Education Asia, Indian Reprint, 2007 (for Unit III)
	3. C.V.Durell and A. Robson, Advanced Trigonometry, Courier
	Corporation, 2003, (for Unit II, IV & V)
Reference Books	1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education,
	Delhi, 2005
	2. J.Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry,
	Cengage Learning, 2012.
	3. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny,
	Pearson Publication, 9 th Edition, 2010.
	4. Dr.P.R.Vittal &V.Malini, Algebra, Analytical Geometry
	&Trigonometry, MarghamPublications,Chennai-17.
	5. T.K.Manickavasagam Pillai & others, Algebra Volume-I, S.V.
	Publications,1985.
Web resources	https://nptel.ac.in/
	https://yutsumura.com/linear-algebra/the-cayley-hamilton-theorem/
	https://www.youtube.com/watch?v=V1AKAkGJlN8

			P	PSOs					
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	-	-	-	3	2	1
CO2	2	1	3	1	-	-	3	2	1
CO3	3	1	3	1	-	-	3	2	1
CO4	3	1	3	-	-	-	3	2	1
CO5	3	1	3	-	-	-	3	2	1

Title of th	ne	DIFFERENTIAL CALCULUS										
Course												
Paper Nu	mber	CORE II	CORE II									
Category	ory CORE Year I Semester I			Ι	Cree	lits	4	Cour	se	24UMACC2		
			Ι				Cout					
Instructional		Lecture	Tu	torial	Lab I		Practi	ce	Total			
Hours ner week												
		4	1			-				5		
Pre-requi	isite	12 th Standard M	athe	matics								
Objective	es of	1.The basic skil	lls o	f differ	entiati	on, su	ccessi	ve diffe	erenti	ation, and their		
the Cours	se	applications.										
		2.Basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.							volutes and			

Course Outcomes:

Students will be able to

CO1: Find the nth derivative, form equations involving derivatives and apply Leibnitz formula

CO2: Find the partial derivative and total derivative coefficient

CO3: Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers

CO4: Find the envelope of a given family of curves

CO5: Find the evolutes and involutes and to find the radius of curvature using polar coordinates

Course Outline	Unit–I (Hours: 15)
	Successive Differentiation
	Introduction (Review of basic concepts) – The n^{th} derivative –
	Standard results – Fractional expressions – Trigonometrical
	transformation – Formation of equations involving derivatives –
	Leibnitz formula for the n^{th} derivative of a product – Feynman's
	method of differentiation.
	Chapter 3 (Sections 3.1, 3.2 & 3.3)
	Unit–II (Hours: 15)
	Partial Differentiation
	Partial derivatives – Successive partial derivatives –
	Function of a function rule – Total differential coefficient – A
	special case – Implicit Functions.
	Chapter 11 (Sections 11.3-11.5)
	Unit–III (Hours: 15)
	Partial Differentiation (Continued)
	Homogeneous functions – Partial derivatives of a function of
	two variables - Maxima and Minima of functions of two variables -
	Lagrange's method of undetermined multipliers.
	Chapter 11 (Sections 11.3, 11.7, 11.8)
	Unit –IV(Hours: 15)

	Curvature
	Definition of Curvature - Circle, Radius and Centre of
	Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-
	ordinates.
	Chapter 13 (Sections13.1, 13.2, 13.4, 13.7, 13.10)
	Unit –V (Hours: 15)
	Envelope
	Method of finding the envelope – Another definition of
	envelope – Envelope of family of curves which are quadratic in the
	parameter.
	Chapter 14 (Sections 14.1 to 14.4)
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part	examinations UPSC/TRB/NET/UGC - CSIR/ GATE/ TNPSC/ others
of Internal Component	to be solved.
only, not to be	
included in the	(To be discussed during the Tutorial hour)
External Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
the course	Competency, Professional Communication and Transferrable Skill
Recommended	1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed.,
Text	Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi,
	2007. (For Unit I, II & III)
	2. N.P. Bali, Golden Differential Calculus, Laxmi Publications (P)
	Ltd. 2010. (For Unit IV &V)
Reference Books	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons,
	Inc., 2002.
	2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010.
	3. K. Courant and F. John, Introduction to Calculus and Analysis
	(volumes I & II), Springer- Verlag, New York, Inc., 1989.
	4. 1. Apostol, Calculus, volumes I and II.
	5 S. Coldhana, Coloulus and mathematical analysis
	5. S. Goldberg, Calculus and mathematical analysis.
Web resources	5. S. Goldberg, Calculus and mathematical analysis. https://nptel.ac.in/
Web resources	5. S. Goldberg, Calculus and mathematical analysis. <u>https://nptel.ac.in/</u> <u>https://arcsecond.wordpress.com/2009/05/10/feynmans-</u>

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	-	-	-	3	2	1
CO2	2	1	3	-	-	-	3	2	1
CO3	3	2	3	2	-	-	3	2	1
CO4	3	2	3	2	1	-	3	2	1
CO5	3	2	3	2	1	-	3	2	1

Subject Code	Subject Name	Category	L	Т	Р	Credits	Inst. Hours	Marks
24UMAGEC1	PHYSICS – I	Generic Elective				3	3	70

COURSE	GENERIC ELECTIVE-I
COURSE TITLE	PHYSICS - I
CODE	24UMAGEC1
CREDITS	3
HOURS	3
COURSE OBJECTIVES	To impart basic principles of Physics that which would be helpful for students who have taken programmes other than Physics.

UNITS	COURSE DETAILS
	WAVES, OSCILLATIONS AND ULTRASONICS: simple harmonic
	motion (SHM) – composition of two SHMs at right angles (periods in the ratio
	1:1) - Lissajous figures - uses - laws of transverse vibrations of strings -
LINIT I	determination of AC frequency using sonometer (steel and brass wires) -
UNII-I	ultrasound – production – piezoelectric method – application of ultrasonics:
	medical field – lithotripsy, ultrasonography – ultrasono imaging- ultrasonics in
	dentistry – physiotheraphy, opthalmology – advantages of noninvasive surgery
	– ultrasonics in green chemistry.
	PROPERTIES OF MATTER: <i>Elasticity</i> : elastic constants – bending of beam –
	theory of non- uniform bending - determination of Young's modulus by non-
	uniform bending - energy stored in a stretched wire - torsion of a wire -
	determination of rigidity modulus by torsional pendulum
UNIT-II	Viscosity: streamline and turbulent motion - critical velocity - coefficient of
	viscosity – Poiseuille's formula – comparison of viscosities – burette method,
	Surface tension: definition - molecular theory - droplets formation-shape, size
	and lifetime – COVID transmission through droplets, saliva – drop weight method
	- interfacial surface tension.
	HEAT AND THERMODYNAMICS: Joule-Kelvin effect – Joule-Thomson
	porous plug experiment – theory – temperature of inversion – liquefaction of
	Oxygen-Linde's process of liquefaction of air-liquid Oxygen for medical
UNIT-III	purpose– importance of cryocoolers – thermodynamic system – thermodynamic
	equilibrium – laws of thermodynamics – heat engine – Carnot's cycle – efficiency
	– entropy – change of entropy in reversible and irreversible process.
	ELECTRICITY AND MAGNETISM: potentiometer – principle –
UNIT-IV	measurement of thermoemf using potentiometer –magnetic field due to a current
	carrying conductor – Biot-Savart's law – field along the axis of the coil carrying
	current – peak, average and RMS values of ac current and voltage – power factor

	and current values in an AC circuit – types of switches in household and factories–								
	Smart wifi switches- fuses and circuit breakers in houses								
	DIGITAL ELECTRONICS AND DIGITAL INDIA: logic gates, OR, AND,								
	NOT, NAND, NOR, EXOR logic gates – universal building blocks – Boolean								
UNIT-V	algebra – De Morgan's theorem – verification – overview of Government								
	initiatives: software technological parks under MeitY NIFLIT- semiconductor								
	laboratories under Dept. of Space an introduction to Digital India								
	$\frac{1}{1 - P Murrageon (2001)} Allied Physics S Chend & Co. New Delhi$								
	2 Brijlal and N Subramanyam (1994) Wayes and Oscillations Vikas								
	2. Diffiai and N.Sublamanyani (1994), waves and Osemations, vikas Publishing House New Delbi								
	3 Brijlal and N Subramaniam (1994) Properties of Matter S Chand & Co								
TEXT	New Delhi.								
BOOKS	4. J.B.Rajam and C.L.Arora (1976). Heat and Thermodynamics (8 th edition),								
	S.Chand & Co., New Delhi.								
	5. R.Murugesan (2005), Optics and Spectroscopy, S.Chand & Co, New Delhi.								
	6. A.Subramaniyam, Applied Electronics 2 nd Edn., National Publishing Co.,								
	Chennai.								
	1. Resnick Halliday and Walker (2018). Fundamentals of Physics								
KS	(11 th edition),								
0	2. John Willey and Sons, Asia Pvt. Ltd., Singapore.								
BC	3. V.R.Khanna and R.S.Bedi (1998), Text book of Sound 1 st Edn.								
Ę	Kednarnaath Publish & Co, Meerut.								
N	4. N.S.Khare and S.S.Srivastava (1983), Electricity and Magnetism 10 th Ec								
RE	5 D R Khannaand H R Gulati (1979) Ontice S Chand & Co I td New								
FE	Delhi								
RE	6. V.K.Metha (2004). Principles of electronics 6 th Edn. S.Chand and								
	company.								
	1. <u>https://youtu.be/M_5KYncYNyc</u>								
	2. <u>https://youtu.be/ljJLJgIvaHY</u>								
	3. <u>https://youtu.be/7mGqd9HQ_AU</u>								
	4. <u>https://youtu.be/h5jOAw57OXM</u>								
WEB	5. <u>https://learningtechnologyofficial.com/category/fluid-mechanics-lab/</u>								
LINKS	6. <u>http://hyperphysics.phy-</u>								
	astr.gsu.edu/hbase/permot2.htmlhttps://www.youtube.com/watch?v=g18								
	https://www.youtube.com/watch?v=9mXUMZUruMQ&t=1s								
	<u>nups.//www.youtube.com/watch?v=m4u-</u> SuaSu1s&t=3shttps://www.biolinscientific.com/blog/what.are.surfectents								
	and-how-do-they-work								
LINKS	astr.gsu.edu/hbase/permot2.htmlhttps://www.youtube.com/watch?v=gT8 Nth9NWPMhttps://www.youtube.com/watch?v=9mXOMzUruMQ&t=1s https://www.youtube.com/watch?v=m4u- SuaSu1s&t=3shttps://www.biolinscientific.com/blog/what-are-surfactants- and-how-do-they-work								

COURSE OUTCOMES:

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

COURSE OUTCOMES	C01	Explain types of motion and extend their knowledge in the study of various dynamic motions analyze and demonstrate mathematically. Relate theory with practical applications in medical field.
	CO2	Explain their knowledge of understanding about materials and their behaviors and apply it to various situations in laboratory and real life. Connect droplet theory with Corona transmission.
	CO3	Comprehend basic concept of thermodynamics concept of entropy and associated theorems able to interpret the process of flow temperature physics in the background of growth of this technology.
	CO4	Articulate the knowledge about electric current resistance, capacitance in terms of potential electric field and electric correlate the connection between electric field and magnetic field and analyze the mathematically verify circuits and apply the concepts to construct circuits and study them.
	CO5	Interpret the real life solutions using AND, OR, NOT basic logic gates and intend their ideas to universal building blocks. Infer operations using Boolean algebra and acquire elementary ideas of IC circuits. Acquire information about various Govt. programs/ institutions in this field.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes (CO) for each course with program outcomes (PO) in the 3-point scale of STRONG (S), MEDIUM (M) and LOW (L).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	М	S	S	S	М	S	S	S	S	М
CO3	М	S	S	S	S	М	S	S	S	S
CO4	S	S	S	S	S	S	S	М	S	S
CO5	М	S	S	S	S	S	S	S	S	S

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	100	

COURSE OUTCOMES:

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

COURSE	CO1	Explain types of motion and extend their knowledge in the study of various dynamic motions analyze and demonstrate
OUTCOMES		mathematically. Relate theory with practical applications in medical field.

		Explain their knowledge of understanding about materials and
	CO2	their behaviors and apply it to various situations in laboratory
		and real life. Connect droplet theory with Corona transmission.
		Comprehend basic concept of thermodynamics concept of
	CO3	entropy and associated theorems able to interpret the process of
	005	flow temperature physics in the background of growth of this
		technology.
		Articulate the knowledge about electric current resistance,
		capacitance in terms of potential electric field and electric
	CO4	correlate the connection between electric field and magnetic
		field and analyze the mathematically verify circuits and apply
		the concepts to construct circuits and study them.
		Interpret the real life solutions using AND, OR, NOT basic
		logic gates and intend their ideas to universal building blocks.
	CO5	Infer operations using Boolean algebra and acquire elementary
		ideas of IC circuits. Acquire information about various Govt.
		programs/ institutions in this field.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes (CO) for each course with program outcomes (PO) in the 3-point scale of STRONG (S), MEDIUM (M) and LOW (L).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	М	S	S	S	М	S	S	S	S	М
CO3	М	S	S	S	S	М	S	S	S	S
CO4	S	S	S	S	S	S	S	М	S	S
CO5	М	S	S	S	S	S	S	S	S	S

COURSE	GENERIC ELECTIVE –I
COURSE TITLE	PHYSICS PRACTICAL - I
CODE	24UMAGECQ1
CREDITS	2
HOURS	2
COURSE OBJECTIVES	Apply various physics concepts to understand Properties of Matter and waves, set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

ANY Seven only

- 1. Young's modulus by non-uniform bending using pin and microscope
- 2. Young's modulus by non-uniform bending using optic lever, scale and telescope
- 3. Rigidity modulus by static torsion method.
- 4. Rigidity modulus by torsional oscillations without mass
- 5. Surface tension and interfacial Surface tension drop weight method
- 6. Comparison of viscosities of two liquids burette method
- 7. Specific heat capacity of a liquid half time correction
- 8. Verification of laws of transverse vibrations using sonometer
- 9. Calibration of low range voltmeter using potentiometer
- 10. Determination of the rmosemf using potentiometer
- 11. Verification of truth tables of basic logic gates using ICs
- 12. Verification of De Morgan's theorems using logic gate ICs.
- 13. Use of NAND as universal building block.

Note : Use of digital balance permitted

Title of the Course		MATHEMATICS FOR COMPETITIVE EXAMINATIONS								
Paper Number		NME I								
Category	Category Skill		Year		I Cred		2	Course	24UMASEC1	
		Semester		Ι				Code		
Instructional Hours		Lecture T		utorial		Lab Practice			Total	
per weel	X									
•		2	-				-		2	
Pre-requ	iisite	12 th Standard Mathematics								
Objectiv	es of the	1. To introduce the basic concepts of Mathematics.								
Course		2. To make them to find simple and compound interest.								
3. To promote the problem solving ability to write the constraint of the solution.						ite the competitive				

Course Outcomes:

Students will be able to

CO1: Recognize the notions on numbers and averages

CO2: Understand the concepts of profit and loss, ratio and proportion, partnership, simple interest and compound interest problems

CO3: Apply the concepts obtained in the course to solve real life problems

CO4: Infer solutions about the partnership and rate of proportionality appropriately.

CO5: Analyze the problems on profit and loss and inspect the odd man out series.

Course outline	Unit – I (Hours: 6)
	Averages Problems on Numbers
	Section I. Chapter 6. Solved examples 1-15 only (Page No. 130-
	Section-1 – Chapter σ – Solved examples 1-15 only (Page No. 161-163).
	Unit II (Hours: 6)
	Durafit and Loop
	Piolit and Loss
	Section-1 – Chapter 11 – Solved examples 1-29 only (Page No.251-
	256).
	Unit – III (Hours: 6)
	Ratio and Proportion, Partnership
	Section-I – Chapter 12 – Solved examples 1-7 only (Page No.294-
	296), Chapter 13 (Page No.311-325).
	Unit – IV (Hours: 6)
	Simple Interest, Compound Interest
	Section-I – Chapter 21 – Solved examples 1-12 only (445-447),
	Chapter 22 – Solved examples 1-15 only (466-470).
	Unit – V (Hours: 6)
	Odd Man Out and Series
	Section-I – Chapter 35 (Page No.649-657).

Extended Professional	Questions related to the above topics, from various competitive						
Component (is a part of	examinations UPSC/TRB/NET/UGC - CSIR/ GATE/ TNPSC/ others						
Internal Component	to be solved.						
only, not to be included							
in the External							
Examination question							
paper)							
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional						
the course	Competency, Professional Communication and Transferrable Skill						
Recommended Text	Dr. R. S. Aggarwal- Quantitative Aptitude for Competitive						
	Examinations (Fully Solved) (Seventh Revised Edition), S. Chand &						
	Company Pvt. Ltd						
Reference Books	Abhijit Guha - Quantitative Aptitude for All Competitive						
	Examinations, McGraw Hill Education, Sixth edition.						
Web resources	1. <u>https://ncert.nic.in/ncerts/l/gemh108.pdf</u>						
	2. <u>https://ncert.nic.in/textbook/pdf/femh112.pdf?html</u>						
	3. https://ncert.nic.in/ncerts/l/hemh108.pdf						

Title of tl	he Course	BRIDGE MATHEMATICS								
Paper Nu	ımber	FOUNDATION COURSE								
Category	Skill Enhancomont	Year		Ι	Cred	it	2	Course	24UMASEFC	
	Elinancement	Semester		I	5			Coue		
Instructional Hours per week		Lecture Tutorial				La	b Prac	tice	Total	
		2	2 -				•	-	2	
Pre-requ	isite	12 th Standa	ard	Mather	natics					
Objective	es of the	1.To bridg	e tł	he gap a	nd faci	ilitat	the the t	ransition fi	om higher	
Course	secondary to tertiary education;									
		2.To instill confidence among students and inculcate intered Mathematics.								

Course Outcomes:

Students will be able to

- **CO1:** Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also, solve the related problems
- **CO2:** Find the various sequences and series and solve the problems related to them. Explain the principle of counting.
- **CO3:** Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations
- **CO4:** Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and submultiple angles, etc. Also, they can solve the problems using the transformations.
- **CO5:** Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.

Course Outline	UNIT-I: (Hours: 6)						
	Algebra: Binomial theorem, General term, middle term, problems						
	based on these concepts						
	Unit II: (Hours: 6)						
	Sequences and series (Progressions). Fundamental						
	principle of counting. Factorial n.						
	Unit III:(Hours: 6)						
	Permutations and combinations, Derivation of formulae						
	and their connections, simple applications, combinations with						
	repetitions, arrangements within groups, formation of groups.						

	Unit IV: (Hours: 6)
	Trigonometry: Introduction to trigonometric ratios, proof of $sin(A+B)$, $cos(A+B)$, $tan(A+B)$ formulae, multiple and sub multiple angles, $sin(2A)$, $cos(2A)$, $tan(2A)$ etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule.
	Unit V: (Hours: 6)
	Calculus: Limits, standard formulae and problems, differentiation, first principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.
Recommended Text	1. NCERT class XI and XII text books.
	2. Any State Board Mathematics text books of class XI and XII
Web resources	https://nptel.ac.in/

		Pos									
	1	2	3	4	5	6	1	2			
C01	1	1	1	1	1	1	1	1			
CO2	2	1	1	2	2	1	2	1			
CO3	2	1	1	2	2	1	2	1			
CO4	1	1	1	1	1	1	2	1			
C05	1	1	1	1	1	1	2	1			

Title of the	e Course	ANALYTICA	L GE	OMETRY	(TW	O & THREE	DIMENSIONS)				
Paper Nu	mber	CORE III									
Category	gory CORE Year I Credits 4 Co						24UMACC3				
		Semester	II			Code					
Instructio	nal	Lecture	Tute	orial	La	b Practice	Total				
Hours per	· week	4		1		-	5				
Pre-requis	site	12 th Standard M	Iather	matics							
Objectives Course	s of the	 Necessary s and three-di To present r To solve rea 	ry skills to analyze characteristics and properties of two- e-dimensional geometric shapes. ent mathematical arguments about geometric relationships. e real world problems on geometry and its applications.								
CO1: ass CO2: unc CO3: lea rela CO4: ana dist CO5: exp	will be ab imilate th derstand th rn about ated probl dyse the c tance betw blain in de	le to e basic concepts he concepts of th angle between t ems. concepts of straig veen two given li etail the system o	of Po le Elli wo pl ght lin ines <u>f Sph</u>	olar Equation ipse, the Hyp lanes, Symn les, coplanar leres.	ns of perbo netric ity o	Straight Line bla and Conic cal form of Ec f straight lines	and Circle quations and solve and shortest				
Course Outline		Coordinates, Le Polar coordinates The Straight Lir The Circle: Equa Chapter 2 (Secti Chapter 5 (Secti Chapter 8 (Section Unit –II (Hours: The Ellipse: Pole The Hyperbola: Polar Equation Normal. Chapter 12 (Section Chapter 13 (Section Chapter 13 (Section Chapter 14 (Section Chapter 14 (Section) Chapter	ength ne: Po ation t ons 3 ons 3 ons 3 ons 3 ons 13 15) e and Asyn to a (tions tions ions 3 15) Straig Plane	of Straigh olar Equation to a Tangent 0-35) 8-96) 8-147) Polar - Conj nptotes Conic: Pola 274-292) 312 -327) 335-347) ght line, Vo	t Li ns an jugat r Eq Jum ral E	nes and Area d Oblique Coo e Diameters. uation to a Ta e of the Tetra quation to a Pl	as of Triangles: ordinates				

	given Planes - The Equation to a Straight Line - Symmetrical form of Equation.
	Chapter - 3 (Sections 33 - 35, 37 - 40)
	Unit –IV (Hours: 15)
	The Plane, The Straight line, Volume of the Tetrahedron: The Line through two given Points - The Direction Ratios found from the Equations - Constants in the Equation to a Line - The Plane and the Straight Line - The intersection of Three Planes - The Condition that two given Lines should be Coplanar - The Shortest Distance between two given Lines.
	Chapter - 3 (Sections41 - 45,48 & 49)
	Unit -V (Hours: 15)
	The Sphere: The Equation to a sphere - Tangents and Tangent Plane to a Sphere - The Radical Plane of two Spheres.
	Chapter - 5 (Sections 56 - 58)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved. (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Text	 S. L. Loney, Co-ordinate Geometry (For Units I & II). Robert J. T. Bell, Co-ordinate Geometry of Three Dimensions. (For Units III, IV & V)
Reference Books	 Thomas G.B and Finney R. L, Calculus and Analytical Geometry, Pearson Publication, 9th Edition, 2010. Manicavachagom Pillay T. K and Natarajan T, A Text book of Analytical Geometry Part I- Two Dimensions, Divya Subramanian for Ananda Book Depot, 1996 Shanti Narayanan and Mittal P.K, Analytical Solid Geometry, S. Chand Publishing, 2021. Vittal P.R and Malini V, Algebra, Analytical Geometry & Trigonometry, Margam Publications, India, 2018 William F. Osgood and William C. Graustein, Plane and Solid Analytic Geometry, Macmillan Company, New York, 2016.
Web resources	https://nptel.ac.in

							-		
			P		PSOs				
	1	2	3	4	5	6	1	2	3
C01	2	2	2	1	-	-	3	2	1
CO2	2	2	2	1	-	-	3	2	1
CO3	3	2	2	1	-	-	3	2	1
CO4	3	2	3	1	-	-	3	2	1
CO5	3	2	3	1	-	-	3	2	1

Title of th Course	he	INTEGRAL CALCULUS											
Paper Nu	ımber	CORE IV	CORE IV										
Category	CORE	Year		Ι	Cree	lits	4	Cour	se	24UMACC4			
		Semester		Π				Code					
Instructi	onal	Lecture	Tu	torial		Lab	Practi	ce	Tot	al			
Hours pe	er week	4		-			-			4			
Pre-requ	isite	12 th Standard M	ather	natics									
Objectives of the Course1.Knowledge on integration and its geometrical applications, do integrals and improper integrals. 2. Knowledge about beta and gamma functions and the applicat 								ns, double, triple					
Course C Students CO1: det findthe re	Jutcome will be al ermine the duction f	s: ble to he integrals of alg formulae.	ebrai	c, trigo	onome	tric and	d logar	rithmic	funct	ions and to			
CO2: eva	luate do	uble and triple int	egral	s and p	robler	ns usin	ng char	nge of c	order	of integration			
CO3: sol	ve multip	ple integrals and t	o fino	d the ar	eas of	curved	d surfa	ces and	l volu	mes of solids			
of revolut	ion												
CO4: exp	olain beta	and gamma func	ctions	and to	use th	nem in	solvin	g probl	ems o	of integration			
CO5: exp	olain geor	metric and physic	al ap	plicatio	ons of	integra	al calcu	ulus					
Course C	Outline	Unit – I (H	lours	: 12)									
		Reduction formulae - Types, integration of product of powers algebraic and trigonometric functions, integration of product of power of algebraic and logarithmic function - Bernoulli's formula, Feyman technique of integration											

Chapter 1 (Sections 13,14 and 15)

	Unit – II (Hours: 12)
	Multiple Integrals - definition of double integrals -evaluation of
	double integrals - double integrals in polar coordinates - Change of
	order of integration.
	Chapter 5 (Sections 1 2 1 2 2 and 3 1)
	Chapter 5 (Sections 1,2.1, 2.2 and 3.1)
	Unit–III (Hours: 12)
	Triple integrals - applications of multiple integrals - volumes of
	solids of revolution - areas of curved surfaces - change of variables -
	Jacobian.
	Chapter 5 (Sections 4, 5.1, 5.2, 5.3 6.1 and 7)
	Chapter 6 (Sections 1.1 and 1.2
	Unit –IV (Hours: 12)
	Beta and Gamma functions - infinite integrals - definitions -
	recurrence formula of Gamma functions - properties of Beta and
	Gamma functions - relation between Beta and Gamma functions -
	Applications.
	Chapter 7 (Sections 2.1,2.2, 2.3, 3.4 and 6)
	Unit –V (Hours: 12)
	Geometric Applications of Integration – Areas under the plane Curves: Cartesian coordinates- Area of a closed curv – Areas in polar coordinates – Trapezoidal rule – Simpsons Rule and Physical Applications of Integral Calculus – Centroid – Center of mass of an arc- Center of mass of a plane area – Centroid of a solid of revolution - Centroid of a surface of revolution
	Chapter 2(Sections 1.1 -1.4, 2.1, 2.2)
	Chapter 3 (Sections 1.1 -1.5 simple applications)
Extended Professional	Questions related to the above topics, from various competitive
of Internal Component	examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others
only not to be	to be solved.
included in the	
External Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
the course	Competency, Professional Communication and Transferrable Skill
Recommended	Narayanan and Manicavachogam Pillai T.K, Calculus -II (2006),
Text	S.Viswanathan Printers Ltd.

Reference Books	1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons,
	Inc.,2002.
	 2.D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd. 3. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 2. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer Undergraduate Mathematics Series, 2001(second edition).
Web resources	https://nptel.ac.in/

			P	08				PSOs 1 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2	
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	-	-	-	3	2	1
CO2	3	1	3	-	-	-	3	2	1
CO3	3	1	3	-	-	-	3	2	1
CO4	3	1	3	-	-	-	3	2	1
CO5	3	1	3	-	2	1	3	2	1

Subject Code	Subject Name	Category	L	Т	Р	Credits	Inst. Hours	Marks
24UMAGEC2	PHYSICS –II	Elective	2	1	-	3	3	70

COURSE	ELECTIVE-II (GE)
COURSE TITLE	PHYSICS –II
CREDITS	3
COURSE OBJECTIVES	To understand the basic concepts of optics, modern Physics, Relativity, quantum physics, semiconductor physics and electronics

UNITS	COURSE DETAILS
	OPTICS: Interference – interference in thin films –colors of thin films –
LINUT I	air wedge – determination of diameter of a thin wire by air wedge –
	diffraction – diffraction of light– normal incidence – experimental
UNII-I	determination of wavelength using diffraction grating (no theory) -
	polarization – polarization by double reflection – Brewster's law – optical
	activity – application in sugar industries
	ATOMIC PHYSICS: Atom models – Bohr atom model – mass number
	- atomic number - nucleons - vector atom model - various quantum
UNIT-II	numbers - Pauli's exclusion principle - electronic configuration -
	periodic classification of elements - Bohr magneton - Stark effect -
	Zeeman effect (elementary ideas only).
	NUCLEAR PHYSICS: Nuclear models – magic numbers – shell model
	- nuclear energy – mass defect – binding energy – radioactivity – uses –
	half life - radio isotopes and uses – nuclear fission – energy released in
UNIT-III	fission – chain reaction - atom bomb - nuclear fusion – thermonuclear
	reactions – differences between fission and fusion (elementary ideas
	only).
	INTRODUCTION TO RELATIVITY AND GRAVITATIONAL
	WAVES : Frame of reference – postulates of special theory of relativity
UNIT-IV	– Galilean transformation equations – Lorentz transformation equations
	– derivation – length contraction – time dilation – twin paradox – mass-
	energy equivalence.
	SEMICONDUCTOR PHYSICS: p-n junction diode – forward and
UNIT-V	reverse biasing – characteristic of diode – zener diode – characteristic of
	zener diode – voltage regulator – full wave bridge rectifier.

	1.	R.Murugesan (2005), Allied Physics, S.Chand & Co, New Delhi.
	2.	K.Thangaraj and D.Jayaraman (2004), Allied Physics, Popular Book
		Depot, Chennai.
	3.	Brijlal and N.Subramanyam (2002), Text book of Optics, S.Chand &
TEXT BOOKS		Co, New Delhi.
	4.	R.Murugesan (2005), Modern Physics, S.Chand & Co, New Delhi.
	5.	A.Subramaniyam Applied Electronics, 2 nd Edn., National Publishing
		Co., Chennai.
	1.	Resnick Halliday and Walker (2018), Fundamentals of Physics, 11 th
		Edn., John Willey and Sons, Asia Pyt. Ltd., Singapore.
	2.	D.R.Khanna and H.R. Gulati (1979). Optics. S.Chand & Co.Ltd.
		New Delhi.
REFERENCE	3.	A.Beiser (1997), Concepts of Modern Physics, Tata Mc Graw Hill
BOOKS		Publication, New Delhi.
	4.	Thomas L. Floyd (2017), Digital Fundamentals, 11 th Edn., Universal
		Book Stall, New Delhi.
	5.	V.K.Metha (2004), Principles of electronics, 6 th Edn., S.Chand and
		Company, New Delhi.
	1.	https://www.berkshire.com/learning-center/delta-p-
		facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://
		www.youtube.com/watch?time_continue=318&v=D38BjgUdL5U
		<u>&feature=emb_logo</u>
WFRLINKS	2.	https://www.youtube.com/watch?v=JrRrp5F-Qu4
	3.	https://www.validyne.com/blog/leak-test-using-pressure-
		transducers/
	4.	https://www.atoptics.co.uk/atoptics/blsky.htm -
	5.	https://www.metoffice.gov.uk/weather/learn-about/weather/optical-
		ettects
Board of Studies De	ate •	02 11 2023
Dourd of Studies D	un .	

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
30	70	100	

COURSE OUTCOMES:

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

	CO1	To understand the concepts of interference, diffraction and polarizations in optics.							
	CO2	To recall the basics of different atom models and various experiments establishing quantum concepts.							
	CO3	To learn the properties of nuclei, nuclear forces ,structure of							
		atomic nucleus, nuclear models and solve related problems							
~ ~ ~ ~ ~ ~ ~		To an alyze the basic concepts of relativity and							
COURSE	CO4	gravitational waves.							
OUTCOMES	005	To understand the working of semiconductor devices like							
	005	junction diode, Zener diode, transistors and full wave bridge							
		rectifier.							

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes (CO) for each course with program outcomes (PO) in the 3-point scale of STRONG (S), MEDIUM (M) and LOW (L).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	Μ	S	S	S	Μ	S	S	S	S	М
CO3	Μ	S	S	S	S	Μ	S	S	S	S
CO4	S	S	S	S	S	S	S	М	S	S
CO5	Μ	S	S	S	S	S	S	S	S	S

Subject Code	Subject Name	Category	L	Т	Р	Credits	Inst. Hours	Marks
24UMAGECQ2	PHYSICS PRACTICALS - II	Elective	-	-	2	2	2	60

COURSE	Elective Course (GE)
COURSE TITLE	PHYSICS PRACTICAL – II
CREDITS	2
COURSE OBJECTIVES	1.Apply the concepts of Light, electricity and magnetism and waves,2.Set up experiments to verify theories, quantify and analyse the observations.3.To do error analysis and correlate results

Any Eight

- 1. Radius of curvature of lens by forming Newton's rings
- 2. Thickness of a wire using air wedge
- 3. Wavelength of mercury lines using spectrometer and grating
- 4. Refractive index of material of the lens by minimum deviation
- 5. Refractive index of liquid using liquid prism
- 6. Determination of AC frequency using sonometer
- 7. Specific resistance of a wire using PO box
- 8. Thermal conductivity of poor conductor using Lee's disc
- 9. Determination of figure of merit table galvanometer
- 10. Determination of Earth's magnetic field using field along the axis of a coil
- 11. Characterisation of Zener diode
- 12. Construction of Zener/IC regulated power supply
- 13. Construction of AND, OR, NOT gates using diodes and transistor
- 14. NOR gate as a universal building block

Board of Studies Date : 02.11.2023

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
30	70	100	

Title of the	QUANTITATIVE APTITUDE FOR COMPETITIVE EXAMINATIONS							
Course	(FUR I D.A / I D.SU. / I D.UIII)							
Paper Number	NME II	NME II						
Category Skill	Year	I Credits 2		Course Code	24UMASEC2			
ement	Semester	II	-					
	.							
Instructional Hours per	Lecture		Tutorial		Lab Practice	Total		
week	2		-		-	2		
Pre-requisite	12 th Standard M	athemat	ics					
Objectives of	1. To introduce	the basi	c concepts o	f Mat	hematics.			
the Course	2.To make the s	tudents	to acquire k	nowle	dge on Geometry	y and solid		
	and plane fig	ures.						
	3.To initiate the	student	s to find the	volur	ne and surface ar	ea of solids.		
Course Outcon	nes:							
Students will be	able to	mbonal	ICEardI	СМ	noncento do			
CO1: recognize CO2: understan	d the concepts of	area, vo	lume and su	.C.M	area.			
CO3: use the a	cquire knowledge	e to solv	ve the probl	ems i	n numbers, H.C.	F and L.C.M and		
percentag	ge.		-					
CO4: calculate	the area, volume	and surfa	ace area for	geom	etrical shapes and	d solid shapes.		
Course	Unit - I (Hours	• 6)	e the compe	uuve	examinations.			
outline		• •)						
	Operations on N	lumbers						
	Section-I - Cha	pter 1 -	Solved exa	mples	s 1-32 only.(Page	e No. 1-9 only)		
	Unit – II (Hou	rs: 6)						
	H.C.F. and L.C.	M of Nı	umbers.					
	Section-I - Cha	pter 2 (Page No. 30)-45 o	only)			
	Unit - III (Hou	rs: 6)			v *			
	Percentage							
	Section-I - Cha	pter 10	- Solved ex	ample	es 1-33 only. (Pa	ge No.208-214		
	Unit - IV (Hou	rs: 6)						
	Area Section-I - Cha 505 only)	pter 24	- Solved ex	ample	es 1-32 only. (Pa	ge No. 499-		

	Unit - V (Hours: 6)
	Volume and Surface Area
	Section-I - Chapter 25 - Solved examples 1-34 only. (Page No. 549-
	555 only)
Extended	
Professional	
Component (is a	Ouestions related to the above topics, from various competitive
part of Internal	examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to
Component only,	be solved.
not to be	
included in the	
External	
Examination	
question paper)	
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional
from the	Competency, Professional Communication and Transferrable Skill
course	
Recommende	Dr. R. S. Aggarwal- Quantitative Aptitude for Competitive
d Text	Examinations (Fully Solved) (Seventh Revised Edition), S. Chand &
	Company Pvt. Ltd
Reference	Rajesh Verma, Fast Track Objective Arithmetic, Arihant Publications
Books	India Limited, New Delhi, Completely Revised Edition.
Web resources	1. <u>http://ncert.nic.in/ncerts/l/iemh113.pdf</u>
	2. https://yoursmahboob.files.wordpress.com/2016/12/quantramandee
	pbook-1.pdf

Title of the Course		HISTORY AND DEVELOPMENT OF INDIAN									
		MATHEMATICS (FROM VEDIC PERIOD TO MODERN									
		ERA)									
Paper Nu	mber	SEC III									
Category	Skill Enhancement	Year	I Cred		its	2	Course		24UMASEC3		
curegory		Semester	II			-	Code				
Instructio	nal Hours	Lecture	Tuto	orial	La	b Pr	actice	T	otal		
per week		2		-		-		2			
Pre-requi	site	12 th Standard Mat	hema	tics	•						
Objective Course Course (Students CO1: un	s of the Dutcomes: will be able to derstand the fou	 Understand the Ancient Beginnings Grasp the Classical Period Contributions Realize the Colonial Period and Modern Developments 									
CO2: exp Ar CO3: ana Bh CO4: rec per CO5: rea ma con	blore the classic yabhata, and the alyze the mediev askar Acharya a ognize the inter riod, leading to i alize the moder de profound d mmunity.	cal period advancer eir influence on alge val era's contribution and his pioneering of actions between Ind integrated and expan n era's contribution iscoveries and Ind	nents, ebra, t ons, in concep dian a inded ns, wl lia's o	such a rigono cludin ot in ca nd glol mather here In ongoing	s, dias the metric stream in the matric stream in the stream matric stream is the stream in the stream stream stream is the stream stream stream stream stream is the stream stream stream stream stream stream stream stream stream is the stream stream is the stream stream is the stream stream is the stream stream stream stream stre	e Br ry, an e wo us ar nathe cal k n ma le in	ahmas j nd astro rks of N nd contin ematics nowledg themati- the gl	phu non Iath nuo dur ge. cs 1 .oba	tasiddhanta, the ny. nematicians like us functions. ring the colonial like Ramanujan d mathematical		
Course (Dutline	Unit – I (Hours:6	6)								
		Introduction of Mathematics - Evolution of Vedic Mathematics - Features of Vedic Mathematics - Importance of Vedic Mathematics - Sutras - Sub sutras.									
		Unit –II(Hours:6)									
Baudhayana-Apastamba-yajnavalkya-panini-Aryabh varahamihira- Brahmagupta- Bhaskara- Sridharacharya- Bhaskara-II-Madhava of Sang Nilakantha somayaji-Jyeshtadeva-Parameshvara-Ray					ibhata- Mahavira- ingamagrama- Ramanujan.						
		Unit–III (Hours:6)									
		Birth of Zero - Mathematics in Vedas- A									

	Generalized
	Approach for finding the Nth order roots of Numbers.
	Unit-IV (Hours:6)
	A Greedy Algorithm Hidden in Sulbasutra- Sankaras Geometrical Approach to Citrabhanus Ekavimsati Prasnottara.
	Unit –V(Hours:6)
	Vedic Mathematics in Modern Era - Vedic Mathematics in Computer: A survey -Vedic Mathematics- The cosmic software for implementation of fast Algorithms - Analysis of digital signal processing Algorithms based on Vedic Mathematics - Role of Vedic Mathematics in driving optimal solutions for Real Life Problems.
Recommended Text	Proceedings of the National Workshop on Ancient Indian Mathematics with special reference to Vedic Mathematics and Astronomy. Rashtriya Sanskrit Vidyapeetha 2011.
Web resources	https://nptel.ac.in/

Title of the Course		VECTOR CALCULUS AND ITS APPLICATIONS							
Paper Numb	er	CORE V							
Category	CORE	Year	II	Credits	4	Course Code	24UMACC5		
		Semester	III						
Instructional Hours per week		Lecture	Tutorial			Lab Practice	Total		
		3	1			-	4		
Pre-requisite	e	12 th Standard Mathematics							
Objectives of Course	f the	 Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions. Skills in evaluating line, surface and volume integrals. The ability to analyze the physical applications of derivatives of vectors 							

Course Outcomes:

Students will be able to

CO1: Find the derivative of vector and sum of vectors, product of scalar and vector point function

and to Determine derivatives of scalar and vector products

CO2: Applications of the operator 'del' and to Explain soleonidal and ir-rotational vectors **CO3:** Solve simple line integrals

CO4: Solve surface integrals and volume integrals

CO5: Verify the theorems of Gauss, Stoke's and Green's(Two Dimension)

Course Outline	Unit – I (Hours: 12)					
	Vector point function - Scalar point function - Derivative of a					
	vector and derivative of a sum of vectors - Derivative of a product of a					
	scalar and a vector point function - Derivative of a scalar product and					
	vector product.					
	Chapter 1(Sections1.1 -1.5)					
	Unit –II (Hours: 12)					
	The vector operator 'del', The gradient of a scalar point function					
	- Divergence of a vector - Curl of a vector - solenoidal and irrotational					
	vectors – simple applications.					
	Chapter 2(Sections2.1 -2.7)					
	<u> </u>					
	Unit–III (Hours: 12)					
	Laplacian operator, Vector identities - Line integral - simple					
	problems.					
	Chapter 2(Sections2.8) & Chapter 3(Sections 3.1 -3.4)					
	Unit –IV (Hours: 12)					
	Surface integral - Volume integral – Applications					
	Chapter 3(Sections 3.5,3.6)					

	Unit –V (Hours: 12)					
	Gauss divergence Theorem, Stoke's Theorem, Green's Theorem					
	in two dimensions – Applications to real life situations.					
	Chapter 4(Sections 4.1 -4.5)					
Extended	Questions related to the above topics, from various competitive					
Professional	examinations UPSC/TRB/NET/UGC - CSIR/ GATE/ TNPSC/ others					
Component (is a part	to be solved.					
of Internal						
Component only, not	(To be discussed during the Tutorial hour)					
to be included in the						
External Examination						
question paper)						
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional					
from the course	Competency, Professional Communication and Transferrable Skill					
Recommended	1.P. Duraipandian and Laxmi Duraipandian, Vector Analysis Revised					
Text	Edition, Emerald publishers, Chennai					
	2. J.C. Susan, Vector Calculus, , (4th Edn.) Pearson Education, Boston,					
	2012.					
Reference Books	I.A. Gorguis, Vector Calculus for College Students, Xilbius					
	Corporation, 2014.					
	2.J.E. Iviarsuell and A. Tromba, vector Calculus, (5 ^m edn.) W.H.					
	Freeman, New TOFK, 1988.					
Web resources	https://nptel.ac.in/					

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	2	3	1	-	-	3	2	1
CO2	3	2	3	1	2	-	3	2	1
CO3	3	3	3	3	-	-	3	3	1
CO4	3	3	3	3	-	-	3	3	1
CO5	3	3	3	3	2	-	3	3	1

Title of the Course		DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS							
Paper Number					CORE V	Ί			
Category	CORE	Year	II	Credits	4	Course	24UMACC6		
		Semester	III			Code			
Instruct	ional	Lecture]	Futorial	Lab P	ractice	Total		
Hours pe	r week	4		1		-	5		
Pre-req	uisite			12 th	Standard Ma	thematics			
Objectives	of the	1. Knowle	edge	about the m	nethods of so	lving Ordina	ry and Partial		
Cours	se	Differe	ntial	Equations.					
		2. The un	dersta	anding of h	ow Different	tial Equations	s can be used as a		
		powerf	ul toc	ol in solving	problems in	science.			
Course Out	tcomes :								
Students wi	ll be able	e to							
CO1: Deter	rmine sol	lutions of he	moge	eneous equa	tions, non-h	omogeneous	equations of degree		
one	in two va	ariables, solv	ve Be	rnoulli's eq	uations and e	exact differen	tial equations.		
CO2: Find	the solut	tions of equa	ations	of first ord	er but not of	higher degre	ee and to Determine		
part	icular in	tegrals of	alget	oraic, expo	nential, trig	onometric fu	unctions and their		
proc	lucts.								
CO3: Find	solution	s of simulta	neous	linear diff	erential equa	tions, linear e	equations of second		
orde	er and to	find solution	ns usi	ng the meth	od of variation	ons of parame	eters.		
CO 4: Form	n a PDE ular and	by elimina general inte	ting a grals,	rbitrary con to solve La	nstants and a grange's equ	rbitrary funct ations	tions, find complete,		
CO 5: Exp	lain stand	dard forms a	nd So	olve Differe	ntial equation	ns using Cha	rpit's method.		
Course O	outline	UNIT-I: (He	ours:	15)					
		Ordinary D	oiffere	ential Equa	tions: Varia	ble separabl	e - Homogeneous		
		Equation-N	on-He	omogeneou	s Equations	of first degr	eein two variables -		
		Linear Equa	tion -	- Bernoulli'	s Equation-E	xactdifferent	ial equations.		
		(Chapter2: Sections 1 to 6)							
		UNIT-II: (Hours: 15)							
		Equation of first order but of higher degree: Equation solvable for dy/							
		Equation so	lvabl	e for y-Equ	ation solvabl	e for x- Clain	rauts' form - Linear		
		Equations	with	constant c	oefficients-P	articular inte	grals of algebraic,		
		exponential	, trigo	onometric fu	unctions and	their product	s.		
		(Chapter4:	Secti	ions 1,2 ,3 ;	and Chapter	5: 1 to 4)			

	UNIT-III: (Hours: 15)								
	Simultaneous linear differential equations- Linear Equations of the								
	Second Order -Complete solution in terms of a knownintegrals-Reduction								
	to the Normal form-Change of the Independent Variable-Method of								
	Variation of Parameters.								
	(Chapter 6 and Chapter 8: Sections 1 to 4)								
	UNIT-IV: (Hours: 15)								
	Partial differential equation: Formation of PDE by Eliminating								
	arbitrary constants and arbitrary functions- complete integral – singular								
	integral- General integral- Lagrange's Linear Equations – Simple								
	Applications.								
	(Chapter12: 1,2,3, and 4)								
	UNIT-V: (Hours: 15)								
	Special methods – Standard forms- Charpit's Method-Simple								
	Applications.								
Extended	(Chapter 12: 5, and 6) Questions related to the above topics from various competitive								
Professional	examinations UPSC / TNPSC / others to be solved								
Component (is a	(To be discussed during the Tutorial hour)								
part of internal	(10 be discussed during the Tutorial hour)								
component only,									
not to be included									
in the External									
Examination									
question paper)									
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional								
from this course	Competency, Professional Communication and Transferrable Skill								
Recommended	1. Narayanan S and Manicavachagam Pillay T.K. Differential equations and its application, 2006, S. Viswananthan Printers Pvt.								
Text	Ltd.								
	2. G.F. Simmons, Differential equations with applications and								

	1.	Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and
Keierence Books		Sons, 1984.
	2.	I.Sneddon, Elements of Partial Differential Equations, McGraw-
		Hill, International Edition, 1967.
	3.	D.A. Murray, Introductory course in Differential Equations, Orient
		and Longman
	4.	H.T. H.Piaggio, Elementary Treaties on Differential Equations and
		their applications, C.B.S Publisher & Distributors, Delhi, 1985.
	5.	Horst R. Beyer, Calculus and Analysis, Wiley, 2010.
	6.	Braun, M. Differential Equations and their Applications. (3rd Edn.),
		Springer- Verlag, New York. 1983.
	7.	TynMyint-U and Lognath Debnath. Linear Partial Differential
		Equations for Scientists and Engineers. (4th Edn.) Birhauser, Berlin.
		2007.
	8.	Boyce, W.E. and R.C.DiPrima. Elementary Differential Equations
		and Boundary Value Problems. (7th Edn.) John Wiley and Sons, Inc.,
		New York. 2001.
	9.	Sundrapandian, V. Ordinary and Partial Differential Equations,
		Tata McGraw Hill Education Pvt.Ltd. New Delhi, 2013
Website and		https://nptel.ac.in
e-Learning Source		

	Pos							PSOs		
	1	2	3	4	5	6	1	2	3	
CO1	3	1	3	2	1	-	3	2	1	
CO2	3	1	3	2	1	-	3	2	1	
CO3	3	1	3	2	1	-	3	3	1	
CO4	3	1	3	2	2	1	3	3	1	
CO5	3	1	3	2	2	1	3	3	1	

Strong-3; Medium-2; Low-1

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Title of the Course	MATHEMATICAL STATISTICS - I								
Paper Number	DISCIPLINE SPECIFIC								
Category ELEC	Year	II	Credits	5	Course	24IIMADSEC1			
IIVE	Semester	III			Code	240MADSEC1			
Instructional	Lecture		Tutorial	La	ab Practice	Total			
Hours per week	5	5			-	5			
Pre-requisite	Basics of Statistic	cs							
Objectives of the Course	 To introduce distribution and To introduce the 	the bas l measu ne statis	sic concepts ires. itical concep	of ts ar	random vari	ables, probability nalytical skills.			
2. To introduce the statistical concepts and develop analytical skills. Course Outcomes: Students will be able to CO1: learn the concepts of characteristic functions, cumulants, conditional expectation, regression, curve fitting, measures of averages, dispersion and skewnes: CO2: examine the properties of characteristic function, correlation, regression and solve t related problems. CO3: Applying the principle of Least squares for fitting of a curve. CO4: evaluate the reliability and validity of statistical findings based on distributions a measures used. CO5: solve society connect problems using mathematical statistics concepts. Course Outline Unit – I (Hours: 12) Characteristic Functions: Definition, Properties of characterist function, Moments from the characteristic function, Inversi theorem, Probability generating function – Definition, Probabili generating function of Binomial distribution and Poiss distribution, Additive Property, Relation between PGF and MC and examples. Cumulants: Conditional Expectation: Definition, Theorems on condition expectation and examples. Part I: Chapter 3 (Page No.: 6.1 – 6.46) Part I: Chapter 3 (Page No.: 7.1 – 7.11) Unit – II (Hours: 12) Correlation: Definition, Rank correlation, Properties of correlati coefficient, Limitations, Examples. Regression – Derivation of Regression lines, Properties regression coefficients, Examples. Regression – Derivation of Regression lines, Properties regression coefficients, Examples. </td									

	Unit - III (Hours: 12)						
	Curve Fitting : Method of least square - Fitting of a straight line and second-degree Parabola, Fitting of Power Curve and Exponential Curves - Simple Problems.						
	Part I: Chapter 10 (Page No.: 10.1 – 10.14)						
	Unit - IV (Hours: 12)						
	 Binomial Distribution: Definition, Binomial frequency distribution and Examples. Poisson Distribution: Definition and Examples of Poisson Distribution. Normal distribution: Definition, standard normal probability distribution and Examples. 						
	Part I: Chapter 12 (Page No.: 12.1 – 12.16) Part I: Chapter 13 (Page No.: 13.1 – 13.12) Part I: Chapter 16 (Page No.: 16.1, 16.13 - 16.27)						
	Unit –V (Hours: 12)						
	 Measures of Averages: Definitions - Mean, Median, Mode, Geometric mean, Harmonic mean - Merits and demerits. Measures of Dispersion: Range, Quartile deviation, Mean deviation and their coefficients - Standard deviation - Co-efficient of Variation - Merits and demerits. Measure of Skewness: Karl Pearson's and Bowley's Coefficient of Skewness. 						
	Part II: Chapter 5 (Page No.: 5.1 – 5.22) Part II: Chapter 6 (Page No.: 6.1 – 6.37) Part II: Chapter 7 (Page No.: 7.1 – 7.18)						
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved.						
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						
Recommended Text	1. Vittal P. R, Mathematical Statistics, Margham Publications, Chennai. (For Units I - V)						

Reference Books	1. Gupta S. C and Kapoor V. K, Fundamentals of
	Mathematical Statistics, Sultan Chand & Sons, New Delhi(11th
	edition)2004.
	2. Gupta. S. P. (2001), Statistical Methods, Sultan Chand &
	Sons, New Delhi.
	3. Sancheti D. C and Kapoor V. K, Statistics (7th Edition),
	Sultan Chand & Sons, New Delhi, 2005.
	4. Robert V. Hogg, Allen T. Craig, Joseph W. Mc Kean,
	Introduction to mathematical statistics, Pearson Education.
	5. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd.,
	Publishers, New Delhi.
	6. Marek Fisz, Probability theory and Mathematical Statistics,
	John Wiley and Sons.
	7. Rohatgi V. K, An Introduction to Probability theory and
	Mathematical Statistics, Wiley Eastern Ltd., Publishers, New
	Delhi.
	8. Arora P. N, Comprehensive Statistical Methods, Sultan
	Chand & Sons, New Delhi.
	9. Hoel P. G, Introduction to Mathematical Statistics, Asia
	Publishing House, New Delhi.
Web resources	https://nptel.ac.in/

				PSOs					
	1	2	3	4	5	6	1	2	3
CO1	3	3	2	2	2	3	3	2	1
CO2	3	3	3	3	2	3	3	2	1
CO3	3	3	3	2	3	3	3	2	1
CO4	3	3	3	2	3	3	2	2	1
CO5	3	3	2	2	2	3	2	2	1

Title of the	e Course	STATIST (PRACTI	TICS CAL)	WITH	EXCEL	PROG	GRAMMING
Paper Nun	nber	SEC – IV					
Category	Skill enhancement (Enterpreneurial based)	Year Semester	II III	Credit	1	Cour Code	rse 24UMASEC Q4
InstructionalHours		Lecture	Tuto	rial	Lab		Total
per week					Practic	e	
		-			1		1
Pre-requis	ite	12 th Standa	ard Ma	thematics	3		
Objectives	of the	To Acquire the knowledge of Statistics with Exc					
Course		Flogramm	mg				

Course Outcomes:

Students will be able to

CO1 : handle distribution of data and analyses the characteristics of data using Excel.

CO2: find Normal distribution, common distribution shapes, Correlation

Coefficient and plot graphs using Excel.

CO3 : create Time-Series Graphs, Dot plots, Stem plots, Bar Charts, Pie Charts using Excel. **CO4 :** compute Mean and Median using Excel.

CO5 : compute Mode, Midrange, Weighted Mean using Excel.

Course Outline	UNIT – I (Hours : 3)								
	Distribution of data- Characteristics of data- Frequency								
	distribution- Procedure for Constructing a Frequency Distribution-								
	Using Excel to Construct a Frequency Distribution-Relative								
	Frequency Distribution-Cumulative Frequency Distribution.								
	Chapter 2 (Page No. 58 - 70)								
	UNIT-II (Hours : 3)								
	Histograms-Relative Frequency Histogram-Normal Distribution-								
	Common Distribution Shapes-Skewness-Using XLSTAT for								
	Histograms-Graphs-Using Excel to Construct a Scatterplot-								
	Correlation Coefficient.								
	Chapter 2 (Page No. 70 - 81)								
	UNIT-III (Hours : 3)								
	Time-Series Graph-Dot plots-Using XLSTAT for Stem plots-Bar								
	Graphs-Using Excel to Create Bar Graphs-Pareto Charts-Pie								
	Charts-Using Excel to Create Pie Charts-Frequency Polygon-								
	Using Excel to Create Frequency Polygons.								
	Chapter 2 (Page No. 81 - 98)								

	UNIT-IV (Hours : 3)								
	Descriptive statistics – Measures of Center – Mean -Using Excel								
	to Calculate the Mean-Median-Using Excel to Find the Median.								
	Chapter 3 (Page No. 110 - 114)								
	UNIT-V (Hours : 3)								
	Mode-Using Excel to Find the Mode-Midrange-Using Excel								
	to Calculate the Midrange-Weighted Mean-Using Excel for								
	DescriptiveStatistics.								
	Chapter 3 (Page No. 114 - 125)								
Recommended	Mario F. Triola, "Elementary Statistics Using Excel",								
Text	Fifth Edition, Pearson New International Edition, 2014.								
Reference Books	1. E. Balagurusamy, "Computer Oriented Statistical and Numerical Methods",								
	Macmillan Publishers India Limited, 2000.								
	 V. K. Rohatgi, A. M. E. Saleh, "An introduction to probability and statistics", 								
	John wiley & Sons, 2015.								
	3. B. Held, B. Moriarty&I. Rehardson, "Microsoft Excel Functions andFormulas", Stylus Publishing, LLC, 2019.								
	 N. J. Salkind, "Excel statistics: A quick guide", SagePublications, 2015. 								
	5. J. Schmuller, "Statistical analysis with Excel for dummies", John wiley & sons, 2013.								
Website and e-Learning Source	https://nptel.ac.in								

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	1	3	-	-	-	3	2	1
CO2	2	1	3	1	-	-	3	2	1
CO3	3	1	3	1	-	-	3	2	1
CO4	3	1	3	-	-	-	3	2	1
CO5	3	1	3	-	-	-	3	2	1

Title of the Course		DATA ANALYTICS WITH R – PRACTICAL								
Paper N	Number	SEC V								
Category	Skill Enhance ment	Year Semester	YearIICredits2Course24SemesterIIICredits2Code24					24UMASECQ5		
Instructio	nal Hours	Lecture	Tuto	rial	I	Lab l	Practice	Total		
perv	week	2	-				-	2		
Pre-re	quisite				-					
Objective Cou	es of the rse	 To familiarize the To understand cor using R studio 	operat mputati	ions oı ons on	n vect 1 Big 1	tors a Data	and matrice analytics a	es using R studio and correlation		
Students v CO1: und CO2: into CO3: app CO4: sol CO5: ana Course	Course Outcomes: Students will be able to CO1: understand the operations on vectors using R CO2: interpret basic operations on matrices using R CO3: apply commands on data frames to understand various operations on it using R CO4: solve Correlation problems with R CO5: analyse the operations on Big Data tables using R Course Outline Unit- I (Hours:6) Getting started with R: Installation – Getting started with the R interface R Nuts and Bolts – Entering Input – Evaluation – R objects – Number – creating vectors – Matrices – Lists – Factors – Missing values – Dat frames –Names – Summary Pages 11 to 22 Unit – II (Hours:6)						it using R with the R bjects – Numbers ing values – Data			
Getting Data III and Out of K Reading and Writing Data – Reading Data Files with read.table() Reading in Larger Datasets with read.table – Calculating Memor Requirements for R Objects Pages 23 to 26 Unit–III (Hours:6) Vectorized Operations: Vectorized Matrix Operations Dates and Times : Dates in R - Times in R - Operations on Dates and Times							h read.table() – lating Memory s ns on Dates and			

Unit-IV (Hours:6) Coding Standards for R Loop Functions
Looping on the Command Line - lapply() - sapply() - split() - Splitting a Data Frame - tapply - apply() - Col/Row Sums and Means - Other Ways to Apply - mapply() - Vectorizing a function
Pages 88 to 106
Data Analysis Case Study: Changes in Fine Particle
Synopsis - Loading and Processing the Raw Data - Results
Pages 131 to 133
Roger D. Peng, R Programming for Data Science.
https://www.google.com/url?sa=t&source=web&rct=j&url=https://sit es.calvin.edu/scofield/course s/m143/materials/RcmdsFromClass.pdf&ved=2ahUKEwjD9butqeTy <u>AhU-</u> 7XMBHf7nDvcQFnoECAMQBg&usg=AOvVaw2cqS0mj02xNYei1 159OIq6

Pages 43 to 48

Mapping of COs with POs and PSOs:

			Po		PSOs				
	1	2	3	4	5	6	1	2	3
CO1	3	1	1	1	1	3	3	2	3
CO2	3	1	1	1	1	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3

Title of th	e Course	INDUSTRIAL STATISTICS							
Paper N	lumber				CC	ORE VII			
Category	CORE	Year]	Π	Credits	4	Co	urse	24UMACC7
		Semester	Ι	V			C	ode	
Instructional		Lecture	e T		Cutorial	Lab Pra	ctice	Total	
Hours		4						4	
per v	veek								
Pre-rec	quisite	12 th Standard Mathematics							
Objectives	of the	1. Enable	stude	ents to	o understand	d and apply	' statis	tical to	echniques and
Cou	rse	data.							
		2. Knowledge about the methods of solving Industrial problems							problems
		using s	tatisti	ics.					

Course Outcomes :

Students will be able to

CO 1: Understand the concepts of Combinatorial and basic probability methods with few examples .

CO 2: Define Sample spaces, probability distributions, Continuous Random variables and The Probability of event .

CO 3: Describe Independent Events and problems.

CO 4: Solve problems on Probability Distributions and Random variables.

CO 5: Describe Conditional Distributions and Mathematical Expectations with moments.

		•									
	UNIT-I: Introduction- Combinatorial Methods- Binomial coefficients.										
	(Chapter1: S	Chapter1: Section-1.1, 1.2, 1.3.)									
	UNIT-II:	UNIT-II: Probability - Introduction-Sample spaces- Events – The									
	Probability	of event- Some	e Rules of Proba	ability.							
	(Chapter2: S	Section-2.1, 2.2	2, 2.3, 2.4, 2.5.)								
	UNIT-III:	Conditional	Probability-	Independent	Events-Baye's						
	Theorem(O	nly problems).									
	(Chapter2: S	Section-2.6, 2.7	7, 2.8.)								
	UNIT-IV:	Probability	Distributions	and Probabil	lity Densities-						
	Introduction	1 - Probability	Distributions-C	Continuous Ran	dom variables-						
	Probability	Density function	ons-Multivariate	e Distributions.							
Course Outline	(Chapter3: S	Section-3.1, 3.2	2, 3.3, 3.4, 3.5.)								

	UNIT-V: Marginal Distributions- Conditional Distributions-								
	Mathematical Expectations- Introduction- The Expected value of a								
	andom variable- Moments.								
	(Chapter3: Section-3.6, 3.7 and Chapter4: Section- 4.1, 4.2, 4.3.)								
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional								
from this course	Competency, Professional Communication, Transferrable Skill and								
	designing mathematical models towards solving mathematical								
	Applications								
Recommended	1. Fruend John E, Mathematical Statistics, Prentice Hall of India, New								
Text	Delhi.								
	1. Papoulis A. Probability, Random Variables and Stochastic process,								
Reference Books	Tata McGraw Hill Education Pvt. Ltd., New Delhi								
	2. Baisnab A., Jas M., Elements of Probability and Statistics, Tata								
	McGraw Hill Education Pvt. Ltd., New Delhi, 1993.								
Website and									
e-Learning Source	https://nptel.ac.in								

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	2	2	3	3	2	2	3	1
CO2	2	3	3	3	3	2	2	3	1
CO3	3	3	3	3	3	2	2	3	1
CO4	2	3	3	2	3	2	2	3	1
CO5	2	3	3	3	3	2	2	3	1

Strong-3; Medium-2; Low-1

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Title of the Course		ELEMENTS OF MATHEMATICAL ANALYSIS							
Paper Numb	er	CORE VIII							
Category	CORE	Year	II	Credits 4		Course Code	24UMACC8		
		Semester	IV						
Instructional	Hours	Lecture		Tutorial		Lab Practice	Total		
per week		3	1				4		
		5							
Pre-requisite	e e	12 th Standard Mathematics							
Objectives of	f the	• Identify and characterize sets and functions and Understand, test							
Course		and analyze the convergence and divergence of sequences,							
series.									
Understand metric spaces w					with	suitable example	es		

Course Outcomes: Students will be able to

CO1: Explain in detail about sets and functions, equivalence and countability and the LUB

axiom

CO2: Explain Sequence and Subsequence of real numbers and to find the limit of sequence to test for convergent, divergent, bounded and monotone sequences

CO3: Explain the operations on convergent and divergent sequences and to Explain the concepts of limit superior and limit inferior and the notion of Cauchy sequences

CO4: Classify the series of real numbers and the alternating series and their convergence and divergence, the conditional convergence and absolute convergence and solve problems on convergence of the sequences

CO5: Explain about the metric spaces and functions continuous on a Metric space

Course Outline	Unit – I (Hours: 12)							
	Sets and Functions: Sets and elements- Operations on sets-							
	functions- real valued functions- equivalence-countability- real							
	numbers- least upper bounds.							
	Chapter 1(Sections1.1 -1.7)							
	Unit –II (Hours: 12)							
	Sequences of Real Numbers: Definition of a sequence and							
	subsequence-limit of a sequence - convergent sequences-divergent							
	sequences- bounded sequences-monotone sequences							
	Chapter 2(Sections2.1 -2.6)							

	Unit–III (Hours: 12)
	Operations on convergent sequences – operations on divergent
	sequences – limit superior and limit inferior-Cauchy sequences.
	Chapter 2(Sections2.7-2.10)
	Unit –IV (Hours: 12)
	Series of Real Numbers: Convergence and divergence – series with non
	-negative terms-alternating series-conditional convergence and
	absolute convergence- tests for absolute convergence.
	Chapter 3(Sections 3.1-3.4 & 3.6)
	Unit –V (Hours: 12)
	Limits and Metric Spaces: Limit of a function on a real line - Metric
	spaces - Limits in metric spaces - Continuous Functions on Metric
	Spaces: Function continuous at a point on there a line-Function
	continuous on a metric space.
	Chapter 4(Sections 4.1 -4.3) Chapter 5(Sections:5.1,5.3)
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others
Component (is a part	to be solved.
of Internal	
Component only, not	(To be discussed during the Tutorial hour)
to be included in the	
External Examination	
question paper)	
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional
from the course	Competency, Professional Communication and Transferrable Skill
Recommended	1. Richard R.Gold Berg, Methods of Real Analysis, Oxford & IBH.
Text	Publications ,New Delhi,2017.
Reference Books	1. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer,
	2011.
	2.G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon
	Press, New York, 1965.
	3. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd.,
	2002.
	4. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John
	Wiley and Sons (Asia) P. Ltd., 2000.
	5. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
	6. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
Web resources	https://nptel.ac.in/
	1

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	2	3	1	1	1	3	2	1
CO2	3	2	3	1	1	1	3	2	1
CO3	3	2	3	2	1	2	3	2	1
CO4	3	2	3	2	1	2	3	2	1
CO5	3	2	3	2	1	2	3	2	1

Title of the Course	MATHEMATICAL STATISTICS - II									
Paper Number	DISCIPLINE S	PECIF	IC							
Category ELEC	Year	II	Credits	3	Course	24UMADSEC2				
five	Semester	IV			Code	240WIADSEC2				
Instructional	Lecture	Lecture			ab Practice	Total				
Hours per week	3	3			-	3				
Pre-requisite	Basics of Statistic	cs			•					
Objectives of the Course1. To understand the concepts of sampling distribution and moments of t-distribution.2. To acquire knowledge about statistical hypothesis and error values 3. To gain knowledge about the testing of significance for Large samples 										
Students will be a CO1: learn the co CO2: understand distribution CO3: estimate th and validate CO4: analyse th distribution CO5: derive the for small sa	ble to oncepts of sampling the notions of Stuc e error value and st e the claims be properties of M as and solve the relat distribution of chi-samples.	g distrib lent t di andard laximun ted pro square,	oution, Estim istribution, n error for me n Likelihoo blems. t and F distr	ation nome an a d es ribut	n and testing ents of chi-sq nd test the hy stimators, ch ion and defer	of hypothesis. Juare, t-test and F- /pothesis for them i-square, t and F nd its applications				
Course Outlin	Unit – I (Ho Sampling distribution characteristi moments. St form of t-dis F-distributio Chapter 22Unit – II (H Estimation: estimator, E) – Blackwell of ML estim Chapter 23	burs: 12 Distri of \overline{X} , ch c funct cudent t stribution. (Page lours: 1 Point xample theore lators an (Page	2) bution: Sani-square dis- ion of χ^2 , A distribution, on and proper- No.: 22.1 - 2 12) Estimation s, Efficiency m, Method on d Examples No.: 23.1 - 2	ampl tribu dditi Mo erties 22.40 : Est , Cra of m 3. 23.25	ing distribu- tion, MGF of tive property, ments of t dis s F – distribu- timator and e amer – Rao ir aximum like 5, 23.46 - 23.5	ution, Sampling f χ^2 - distribution, Relation between stribution, limiting tion, Moments of estimate, unbiased nequality, and Rao lihood, Properties 56)				

	Unit - III (Hours: 12) Large Samples: Population, Parameter and statistic, sampling distribution, Characteristic of sampling distribution, standard error of the mean, test of hypothesis – Procedure, One tail test, two tail test, test for a specified mean, test for equality of two means, test for a specified proportion, test for equality of two proportions.
	 Unit - IV (Hours: 12) Small samples: t Test, uses of t – test, Properties of sampling distribution of t, Test for a specified Mean, Test of significance for the difference between two population means, confidence interval for small samples. F – test, Procedure for equality of two population variances. Chapter 25 (Page No. :25.1 –25.30) Chapter 26 (Page No. :26.1 –26.12))
	Unit –V (Hours: 12) Small samples: chi-square test, Additive property, Pearsons' statistic, uses of χ^2 - test, Test for independence of Attributes, Test for a specified Population Variance, Test of Independence of attributes. Chapter 27 (Page No.:27.1 – 27.46)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved.
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Vittal P. R, Mathematical Statistics, Margham Publications, Chennai. (For Units I - V)
Reference Books	 10. Gupta S. C and Kapoor V. K, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi(11th edition)2004. 11. J. N. Kapur & H. C. Saxena, Mathematical Statistics, S Chand & Company 12. Richard W. Hamming (2004) Methods of Mathematics Applied to Calculus, Probability, and Statistics, Dover Publications, New York
Web resources	https://ocw.mit.edu/courses/18-655-mathematical-statistics-spring-2016/ https://archive.nptel.ac.in/courses/111/105/111105043/

			PSOs						
	1	2	3	4	5	6	1	2	3
C01	3	3	2	2	2	3	3	2	1
CO2	3	3	3	3	2	3	3	2	1
CO3	3	3	3	2	3	3	3	2	1
CO4	3	3	3	2	3	3	2	2	1
CO5	3	3	2	2	2	3	2	2	1

Mapping of COs with POs and PSOs:

Title of th Course	ne	MATHEMATICAL STATISTICS USING R PROGRAMMING - PRACTICAL								
Paper Nu	mber	DISCIPLINE SP	PECIF	IC						
Categorv	ELEC	Year	II	Credits	2	Course	24UMADSECO			
	TIVE	Semester	IV			Code	240111100100			
Instructio	onal	Lecture		Tutorial	Lab Practice Total					
Hours pe	r week	-		-		2	2			
Pre-requi	isite	Basics of Statistic	2S							
Objective the Cours	es of se	 To provide a strong foundation on the practical applications of R-studio To critically evaluate data and determine the most appropriate statistical models for specific scenarios To apply the knowledge of regression analysis in solving real-world problems 								
Course O Students v CO1: rec con CO2: app test CO3: ana squ CO4: eva and CO5: cre regi Course	Putcomes will be all and putation ly the kr s, correla lyze data ared tests luate the chi-squa eate and ression m e Outline	s: ble to understand the basis howledge of R Stud ation coefficients and a and perform advass and regression and a propriateness of a red tests. execute complex hodels, and report the Unit – I Data: Starting Problems. (Page No: 1- Unit – II Bivariate D bivariate data vs. numerical (Page No: 19) Unit - III Hypothesis mean, Tests for (Page No: 6) Unit - IV (Herder)	asics of dio to re and regro anced s alysis, f f vario statist he find ng R-E -7) Pata: H a: categ l, Linea -22) Testin for the 6-68)	f R, includi eal-world pr ession analy statistical tes to draw mea us statistical ical compu- ings. ntering data Iandling biv gorical vs. mar regression g: Testing a median, Pro	ing oble sis. sts, s l dat tatio with varia umen l, Pro-	data entry, ms with the uch as hype ful conclusi a, including ns, includin n c- Data is a te categoric rical, Bivari oblems.	vectors and other e use of chi-squared othesis testing, chi- ions. g hypothesis testing ng correlation and a vector – cal data, Handling ate data: numerical			
		Chi Square Goodness of	Tests Fit Te	The Chi-S sts, Chi-Squ	Squa iarec	red Distrib l Tests for l	ution, Chi-Squared Independence, Chi-			

	Squared Tests for Homogeneity, Problems. (Page No: 72-76)
	Unit –V
	Regression Analysis: Simple Linear Regression Model-Testing the Assumption of the Model-Statistical Inference, Problems.
	(Page No: 77-83)
Extended Professional Component (is a part of Internal Component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC – CSIR/ GATE/ TNPSC/ others to be solved.
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Simple R - Using R for Introductory Statistics by John Verzani.
Reference Books	Statistics – An Introduction using R by Michael J. Crawley, Wiley Publications
Web resources	https://www.geeksforgeeks.org/r-statistics/

		PSOs							
	1	2	3	4	5	6	1	2	3
CO1	3	3	3	3	3	1	3	2	2
CO2	3	3	3	3	3	1	3	2	2
CO3	3	3	3	3	3	1	3	2	2
CO4	3	3	3	3	3	1	3	2	2
CO5	3	3	3	3	3	1	3	2	2

Title of the Cour	se	Computational Mathematics with MATLAB- PRACTICAL							
Paper Number		SEC VI							
Category SKILL		Year	Π	Credits	2	2 Course		24UMASECO6	
ENHAN	CEMENT E	Semester	IV			Code			
Instructional Ho week	urs per	Lecture	Tute	orial	Lab Total Practice			al	
		-		-		2		2	
Pre-requisite		Fundamenta	als of	Mathemati	cs				
Objectives of the	Course	To impart k using Matla	nowle b	edge on sol	lge on solving mathematical problems				
Students will be CO1: apply Mat the proper CO2: execute M points, ma CO3: apply Ma and volun CO4: implemen triple inte CO5: apply Ma Course Outline	able to thab to com- tries of hyp fatlab com- axima, min thab to calc ne of the T at numerica grals thab to solv Unit - I Algebra Creating Values a Trigono Hyperb Unit - I Differen Partial Minima Unit - I Analytic Distance Angle b Unit - IV Numeri Single i multiple	pute determi perbolic and i mands to cor ima, and env culate distance etrahedron al integration ve differentia (Hours: 6) a g and working and Eigen Ve ometry olic Function I(Hours: 6) ntial Calculu Derivatives-5 of functions II(Hours: 6) cal Geometr e between two etween two g (Hours: 6) cal Integrats ntegrals - Do	nants, nverse npute elopes ses bet methe <u>l equa</u> g with ectors <u>ns-Inve</u> s Succe of two y vo poi given I juble	eigenvalue e hyperboli partial deri s of curves ween point ods in MAT tions with i Arrays an erse Hyper ssive parti o variables ants - Asyr Planes - Vo	es, a c fu: ivati is, an FLA d M <u>bolid</u> d M <u>bolid</u> - Er nptc <u>olum</u>	nd eige nctions ves and ngles be B for s al cond fatrices c function derivation	envec I dete etwee ingle <u>itions</u> - Dete <u>ons</u> ive- <u>of fa</u> Cange e Tett	etors, and evaluate ermine critical en two plans e, double, and s erminants - Eigen Maxima and amily of curves ent to a curve - rahedron - Applications of	
	multiple	e integrals							
	Unit - V	(Hours: 6)							
	Different	tial Equation	ns						
	Solve line	ear and nonli	near d	lifferential	equa	ations v	vith i	nitial conditions	
Skills acquired	Knowled	ge, Problem	Solvir	ng, Analytic	cal a	bility,	Profe	essional	
from the course	Compete	ncy, Professi	onal C	<u>Communica</u>	tion	and Tr	<u>ansfe</u>	errable Skill	

Recommended	Rudra Pratap, Getting started with MATLAB							
Text								
Reference	Dingyu Xue and Yangquan Chen, Solutions Manual for Solving Applied							
Books	Mathematical Problems with Matlab, Taylor and Francis Group, LLC,							
	2009.							
Web resources	https://in.mathworks.com/matlabcentral/answers/270283-get-							
	envelope-of-multiples-curve							
	https://in.mathworks.com/matlabcentral/answers/728153-finding-an-							
	equation-of-the-tangent-line-to-a-curve-at-the-given-point-in-matlab							
	https://in.mathworks.com/matlabcentral/answers/496531-how-to-							
	calculate-the-partial-derivatives-for-a-given-function-of-two-variable							

	Pos						PSOs			
	1	2	3	4	5	6	1	2	3	
C01	3	3	3	3	3	1	3	2	2	
CO2	3	3	3	3	3	1	3	2	2	
CO3	3	3	3	3	3	1	3	2	2	
CO4	3	3	3	3	3	1	3	2	2	
CO5	3	3	3	3	3	1	3	2	2	

Title of the Course		LaTeX - PRACTICAL									
Paper Number		SEC – VII									
Category	SKILL		Year	II	Credit	2	Course Code		24UMASECQ7		
	ENHANCE	MENT	Semester	IV							
Instruction	nal Hou	rs	Lecture	Tuto	rial	Lab)	То	tal		
per week						Practice					
			-	2 2							
Pre-requis	site		12 th Standard Mathematics								
Objectives	s of the		To enable	the Stu	udents to prej	oare r	esearch a	rticl	es in LaTeX		
Course			format.			-					
Course Outo	comes:										
Students wi	ll be able to)									
CO1: make	different ali	ignmen	ts in a docu	ument	and an appli	cation	n for a jol)			
CO2: genera	ate bio-data	and tal	ble structur	es.							
CO3: create	Mathemati	ical stat	ements usi	ng La'	TeX.						
CO4: prepai	re articles a	nd inse	rting pictur	es.							
CO5: prepar	re question	paper a	nd power p	point p	presentation in	n LaT	TeX form	at			
Course Ou	utline	UNIT	T-I (Hou	rs : 6)	1						
		Creatio	a of o do	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	4		1: ~~~~~~~~	(I	oft Dicht Contro		
		Creatic		cumer		ent a	ingnmen	IS (L	ent, Right, Centre,		
		Justify	Justify) – typing a letter for appling a job.								
		UNIT	-II (Hours	s : 6)							
		Creatic	reation of own bio-data – Creating a Table Structure.								
		IINIT-	-III (Hours · 6)								
		Typing	a Mothematical Expression involving Differentiation. Interaction								
		i yping	is a manematical Expression involving Differentiation, integration								
		and I	Irigonometry – I yping a Mathematical Expression using all								
		express	pressions and Inequalities.								
		UNIT-	IV (Hours	: 6)							
		Creation of an Article using LaTeX - Inserting Picture in a LaTeX									
			ion of an Autore using Laters - inserting ricture in a Laters.								
		UNIT-	JNIT-V (Hours : 6)								
		Prepari	paring a question paper in LaTeX format - Creation of Power Point								
Deers	1.17.4	1					III.al.	T			
Recomment	(Society for Industrial and Applied Mathematics)Publis Phidelphia, 1996.							arning LaTex, SIAM hematics)Publishers,			
			•								

ReferenceBooks	1 Nambudirinad K B M 2014 LaTeX for beginners Narosa Publishing
Referencebooks	1. Nationality and the second se
	House private limited, New Delhi.
	2. Martin J. Erickson and Donald Bindner, A student's Guide to the Study,
	Practice and Tools of Modern Mathematics, CRC Press, Boca Raton,
	FL, 2011.
	3. L. Lamport, LATEX: A Document Preparation System, User's Guide
	and Reference Manual, Addison-Wesley, Newyork, Second edition,
	1994.
Website and	https://nptel.ac.in
e-Learning Source	

			PSOs						
	1	2	3	4	5	6	1	2	3
CO1	3	3	3	3	3	1	3	2	2
CO2	3	3	3	3	3	1	3	2	2
CO3	3	3	3	3	3	1	3	2	2
CO4	3	3	3	3	3	1	3	2	2
CO5	3	3	3	3	3	1	3	2	2