HANDBOOK

COURSE STRUCTURE AND DETAILED SYLLABUS

B. Tech Programmes
Batch: 2017-21

INSTITUTE OF ENGINEERING AND TECHNOLOGY

JK LAKSHMIPAT UNIVERSITY

Near Mahindra SEZ, Mahapura, Ajmer Road, Jaipur 302 026 Ph.: +91-141-7107500/504

Vision

To be one of India's most innovative higher education institutions.

Mission

To realise its vision, the University will:

Practice teaching that inculcates critical thinking and problem solving,

Pursue research that leads to innovation and enhancement of real-life applications,

Offer experience that leads to all round development, and

Develop a culture that is strongly rooted in interdisciplinarity and learning by building, not just doing.

Values

Caring for people.

Integrity including intellectual honesty, openness, fairness, and trust.

Commitment to excellence.

CONTENTS

Course Structure

Syllabus

JK Lakshmipat University
Institute of Engineering and Technology
Department of Civil Engineering
Course Structure for the B. Tech (Batch 2017-2021)

Sem	Courses							(L T P S) Credits Hrs./Week
I	English Communication Skills	Calculus and Linear Algebra	Engineering Physics	Electrical & Electronics Engineering	Elements of Engineering	Engineering Drawing		(14 2 12 1) 23
	LA101 (1 0 2 1) 3	MA102 (3 1 0 0) 4	PH101 (3 1 2 0) 5	EE101 (3 0 2 0) 4	CM101 (2 0 4 0) 4	CE102 (2 0 2 0) 3		28
II	Creativity and Design Thinking	Differential Equations and Complex Analysis	Engineering Chemistry	Environmental Studies	Engineering Mechanics	Object Oriented Programming	Introduction to Critical Thinking	(18 3 4 0) 22
	LA203 (2 0 0 0) 2	MA202 (3 1 0 0) 4	CH101 (3 1 2 0) 5	ID201 (2 0 0 0) 2	ME201 (3 1 0 0) 4	CSE202 (3 0 2 0) 4	LA204 (2 0 0 0) 1	25
III	Structure Analysis-I	Fluid Mechanics	Surveying	Computer Based Numerical and Statistical Techniques	Effective Communication Design	Intelligent Machines (AI, Robotics, IoT)		(17 2 6 0) 22
	CE305 (3 1 0 0) 4	CE306 (3 1 2 0) 5	CE308 (3 0 2 0) 4	MA302 (3 0 2 0) 4	CCT306 (3 0 0 0) 3	ID303 (2 0 0 0) 2		25
IV	Structure Analysis-II	Engineering Geology and Building Construction	Concrete Technology	Hydraulic Engineering	Advanced Communication & Interpersonal Dynamics	Articulation and Elocution		(14 1 6 0) 18
	CE405 (3 1 0 0) 4	CE402 (3 0 2 0) 4	CE409 (3 0 2 0) 4	CE403 (3 0 2 0) 4	CCT401 (2 0 0 0) 2	CCT202 Audit		21
	PS-I: PS1101 (4 Credits)							
V	Design of RCC and Steel Structures	Geotechnical Engineering	Mechanical and Electrical Machines	Departmental Elective-I/ Open Elective-I	Communication and Identity	Management Perspectives		20/21
	CE1107 (3 0 2) 4	CE1108 (3 0 2) 4	ES1108 (3 0 2) 4	3/4	CC1104 (2 0 1) 2	IL1101 2		23 hrs
VI	Transportation Engineering	Construction Project Management	Departmental Elective-II	Open Elective -II	Critical Thinking for Decisions at Workplace	Introduction to IoT		18/ 20
	CE1109 (3 0 2) 4	CE1112 (3 0 2) 4	4	4/2	CC1106 (2 0 0) 2	EE1111 2		22 hrs
VII	Departmental Elective-III	Departmental Elective-IV	Departmental Elective-V	Open Elective-III	Minor Project	Automation Project		22
	4	4	4	4	PR1103 4	PR1101 2		20 hrs
VII	Practice School-II (PS1102)/Entrepreneurial Project (PR1105)/Research Project (PR1104)/Semester-at a partner University							16
								Total Credits: 164-167

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B. Tech (CE) (Batch 2017-21)

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JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Computer Science and Engineering
Course Structure for the B. Tech (Batch 2017-2021)

Sem	Courses							(L T P S) Credits / Hrs/ Week
I	English Communication Skills	Calculus and Linear Algebra	Engineering Chemistry	Electrical & Electronics Engineering	Engineering Drawing	Object Oriented Programming /Software Foundation and Programming		(14 2 12 1) 23
	LA101 (1 0 2 1) 3	MA102 (3 1 0 0) 4	CH101 (3 1 2 0) 5	EE101 (3 0 2 0) 4	CE102 (2 0 2 0) 3	CSE202 (3 0 2 0) 4/ IBM101 (2 0 4) 4		28 Hrs.
II	Creativity and Design Thinking	Differential Equations and Complex Analysis	Engineering Physics	Environmental Studies	Engineering Mechanics	Introduction to Critical Thinking	Elements of Engineering / **Software Foundation and Programming (With C++)**	(18 3 4 0) 22
	LA203 (2 0 0 0) 2	MA202 (3 1 0 0) 4	PH101 (3 1 2 0) 5	ID201 (2 0 0 0) 2	ME201 (3 1 0 0) 4	LA204 (2 0 0 0) 1	CM101 (2 0 4 0) 4/ CSESP201(3 0 2) 4	25 Hrs.
III	Data Structures	Digital Electronics	Computer Based Numerical & Statistical Techniques	Intelligent Machines (AI, Robotics, IoT)	Effective Communication Design	Application Development / **Object Oriented Programming Using JAVA**		(17 3 8 0) 23
	CSE301 (3 1 2 0) 5	ECE310 (3 1 2 0) 5	MA302 (3 0 2 0) 4	ID303 (2 0 0 0) 2	CCT306 (3 0 0 0) 3	CSE304 (3 1 2 0) 4 / CSESP301 (3 1 2 0) 4		28 Hrs.
IV	Discrete Structures	Computer Architecture & Organization	OE-I	Advanced Communication & Interpersonal Dynamics	Articulation and Elocution	Database Management Systems / **Information Management Basics**		17/18
	CSE402 (3 1 0 0) 4	CSE403 (3 0 2 0) 4	(3 0 0 0) 3/4	CCT401 (2 0 0 0) 2	CCT202 Audit	CSE401/CSESP401 (3 0 2 0) 4/ (3 0 2 0) 4		19 Hrs.
	Practice School-I (PS1101) – (4 to 6 Weeks Duration) - 4 Credits							
V	Operating System	Design and Analysis of Algorithms	Theory of Computation and Compiler Design	DE-I/OE-II/**Cloud Computing/Business Intelligence**	Communication and Identity	Management Perspectives		**20**
	CS1108 (3 0 2) 4	CS1105 (3 0 2) 4	CS1109 (3 0 2) 4	CS1304/CS1305 (3 0 2) 4	CC1104 (2 0 1) 2	IL1101 2		23 Hrs.
VI	Computer Networks and Distributed Systems	Artificial Intelligence and Machine Learning	DE-II/ **Security Intelligence/Predictive Analytics Modeler**	OE-III	Critical Thinking for Decisions at Workplace	Introduction to IoT		**20**
	CS1111 (3 0 2) 4	CS1110 (3 0 2) 4	**CS1308/CS1309** 4	4	CC1106 (2 0 0) 2	EE1111 2		22 Hrs.
VII	Advanced Data Structures and Algorithms	Software Engineering	DE-III	OE-IV	Minor Project/**Cyber Security - Identity and Access Management/ Big Data Engineering**	Automation Project PR1101		**22**
	CS1114 (3 0 2) 4	CS1113 (3 0 2) 4	4/5	4	PR1103/CS1311/CS1312 4	2		20/25 Hrs.
VIII	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University PS1102/ PR1105/ PR1104							**16**
	Total Credits							**167-168**

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B.Tech. (CSE) (Batch: 2017-2021)

	Specialisation	
CS2405	Deep Learning	217
OE-IV		
CE1202	Municipal and Urban Engineering	72
IL1203	Economics and Finance for Engineers	75
AS1202	Advanced Statistics	174
EE1212	Information Theory, Coding & Cryptography	195
Sem-VIII		
PS1102/PR1105/ PR1104	Practice School-II/Research Project/ Semester at a partner University	66
Additional Courses		
CS1206	Competitive Programming	184
CS1209	Routing, Switching and Wireless Essential	201
CS1407	Applied AI	211
CS1408	Introduction to Neo4j	213
CS1409	Computer Communication	215
CSESP302	Linux System Administration (Offered only to Redhat specialization students)	333
PR1106	Apprenticeship	334

Note:

- * Indicates the course offered as elective but not opted by students.
- A student may sometimes be allowed to take a few additional courses for earning extra credits, fulfilling credit deficiency or completion of academically equivalent core course requirements in special cases, e.g., lateral entry/transfer cases, semester exchange at partner universities, medical cases, student detention, backlog, etc.

JK Lakshmipat University, Jaipur

Institute of Engineering and Technology

Department of Electronics and Communication Engineering

Course Structure for the B. Tech (Batch 2017-2021)

Sem	Courses							(L T P S) Credits Hrs/ Week
I	English Communication Skills	Calculus and Linear Algebra	Engineering Chemistry	Environmenta l Studies	Engineering Mechanics	Object Oriented Programming		(15 3 6 1) 22
	LA101 (1 0 2 1) 3	MA102 (3 1 0 0) 4	CH101 (3 1 2 0) 5	ID201 (2 0 0 0) 2	ME201 (3 1 0 0) 4	CSE202 (3 0 2 0) 4		24
II	Creativity and Design Thinking	Differential Equations and Complex Analysis	Engineering Physics	Electrical & Electronics Engineering	Elements of Engineering	Engineering Drawing	Introducti on to Critical Thinking	(17 2 10) 23
	LA203 (2 0 0) 2	MA202 (3 1 0 0) 4	PH101 (3 1 2 0) 5	EE101 (3 0 2 0) 4	CM101 (2 0 4 0) 4	CE102 (2 0 2 0) 3	LA204 (2 0 0) 1	29
III	Electronic Devices & Circuits	Digital Electronics	Network Analysis & Synthesis	Computer Based Numerical and Statistical Techniques	Effective Communication Design	Intelligent Machines (AI, Robotics, IoT)		(17 1 8 0) 23
	ECE311 (3 0 2 0) 4	ECE310 (3 1 2 0) 5	EE304 (3 0 2 0) 5	MA302 (3 0 2 0) 4	CCT306 (3 0 0 0) 3	ID303 (2 0 0 0) 2		26
IV	Analog Linear Integrated Circuits	Engineering Signals & Systems	Electromagneti c Field Theory	Open Elective I	Articulation and Elocution	Advanced Communication & Interpersonal Dynamics		(14 2 4/6 0) 19
	ECE489 (3 0 2 0) 5	ECE408 (3 1 2 0) 5	ECE403 (3 1 0 0) 4	(3 0 0 0)/ (3 0 2 0) 3	CCT202 Audit	CCT401 (2 0 0 0) 2		20/22
V*	Practice School - I (PS 1101) – (4 to 6 Weeks Duration)							4
	Mechanical and Electrical Machines	Measurement and Control Systems	Analog and Digital Communication	Department al Elective 1/ Open Elective 1	Communication and Identity	Management Perspectives		20
	ES 1108 (3 0 2) 4	EE1108 (3 0 2) 4	EE1109 (3 0 2) 4	4	CC1104 (2 0 1) 2	IL 1101 2		23 hrs.
	Practice School-I PS1101 4							
VI*	Digital Signal Processing	Microwave Engineering	Departmental Elective 2	Open Elective-2	Critical Thinking for Decisions at Workplace	Introduction to IoT		20
	EE1115 (3 0 2) 4	EE1113 (3 0 2) 4	4	4	CC1106 (2 0 0) 2	EE1111 2		22 hrs
VII*	Departmental Elective 3	Departmental Elective 4	Departmental Elective 5	Open Elective - 4	Minor Project	Automation Projects		22
	4	4	4	4	PR1103 4	PR1101 2		20 hrs
VIII*	Practice School -II /Entrepreneurial Project/Research Project/Semester at a partner University PS1102/ PR1105/ PR1104							16
	Total Credits							169

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B. Tech (ECE) (Batch: 2017-2021)

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JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Electrical Engineering
Course Structure for the B. Tech (Batch 2017-21)

Seme	Courses							(L T P S) Credits Hrs /Week
I	English Communication Skills	Calculus and Linear Algebra	Engineering Chemistry	Environmental Studies	Engineering Mechanics	Object Oriented Programming		(15 3 6 1) 22
	LA101 (1 0 2 1) 3	MA102 (3 1 0 0) 4	CH101 (3 1 2 0) 5	ID201 (2 0 0 0) 2	ME201 (3 1 0 0) 4	CSE202 (3 0 2 0) 4		24
II	Creativity and Design Thinking	Differential Equation and Complexity Analysis	Engineering Physics	Electrical & Electronics Engineering	Elements of Engineering	Engineering Drawing	Introduction to Critical Thinking	(17 2 10 0) 23
	LA203 (2 0 0 0) 2	MA202 (3 1 0 0) 4	PH101 (3 1 2 0) 5	EE101 (3 0 2 0) 4	CM101 (2 0 4 0) 4	CE102 (2 0 2 0) 3	LA204 (2 0 0 0) 1	29
III	Network Analysis & Synthesis	Digital Electronics	Electronic Devices & Circuits	Computer Based Numerical and Statistical Techniques	Effective Communication Design	Intelligent Machines (AI, Robotics, IoT)		(17 1 8 0) 23
	EE304 (3 0 2 0) 5	ECE310 (3 1 2 0) 5	ECE311 (3 0 2 0) 4	MA302 (3 0 2 0) 4	CCT306 (3 0 0 1) 3	ID303 (2 0 0 0) 2		26
IV	Electrical Machines–I	Measurement & Instrumentation	Analog Linear ICs	Open Elective I	Articulation and Elocution	Advanced Communication & Interpersonal Dynamics		(14 2 6 0) 18
	EE484 (3 1 2 0) 4	EE303 (3 1 2 0) 4	ECE489 (3 0 2 0) 5	(3 0 0) 3	CCT202 Audit	CCT401 (2 0 0 0) 2		22
	Practice School - I (PS1101) – (4 to 6 Weeks Duration)							04 Credits
V*	Control Systems	Advanced Electrical Machines	Power Systems-I	DE-I/ OE-II	Communication and Identity		Management Perspectives	20
	EE1106 (3 0 2) 4	EE1103 (3 0 2) 4	EE1107 (3 0 2) 4	(3 0 2) 4	CC1104 (2 0 1) 2		IL1101 (2)	23 hrs
VI*	Industrial Electronics	Power System-II	Departmental Elective II	Open Elective III	Critical Thinking for Decisions at Workplace	Introduction to IoT		20
	EE1112 (3 0 2) 4	EE1114 (3 0 2) 4	(3 0 2) 4	4	CC1106 (2 0 0) 2	EE1111 2		22 hrs
VII*	Departmental Elective III	Departmental Elective IV	Departmental Elective V	Open Elective IV	Minor Project	Automation Project		22
	4	4	4	4	PR1103 4	PR1101 2		20 hrs
VIII*	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University PS1102/ PR1105/ PR1104							16

Total Credit: 168

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B. Tech (EE) (Batch: 2017-2021)

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JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Mechanical Engineering
Course Structure for the B. Tech (Batch 2017-21)

Sem	Courses							(L T P S) Credits Hrs/Week
I	English Communication Skills	Calculus and Linear Algebra	Engineering Physics	Electrical and Electronics Engineering	Elements of Engineering	Engineering Drawing		(14 2 12 1)
	LA101	MA102	PH101	EE101	CM101	CE102		23
	(1 0 2 1) 3	(3 1 0 0) 4	(3 1 2 0) 5	(3 0 2 0) 4	(2 0 4 0) 4	(2 0 2 0) 3		
II	Engineering Mechanics	Differential Equations and Complex Analysis	Engineering Chemistry	Environmental Studies	Object Oriented Programming	Creativity and Design Thinking	Introduction to Critical Thinking	(17 3 4 0)
	ME201	MA202	CH101	ID201	CSE202	LA203	LA204	22
	(3 1 0 0) 4	(3 1 0 0) 4	(3 1 2 0) 5	(2 0 0 0) 2	(3 0 2 0) 4	(2 0 0) 2	(1 0 0) 1	
III	Engineering Thermodynamics	Strength of Materials.	Fluid Mechanics and Machines	Computer Based Numerical and Statistical Techniques	Effective Communication Design	Intelligent Machines (AI, Robotics, IoT)		(17 2 6)
	ME301	ME306	ME308	MA302	CCT306	ID303		22
	(3 1 0) 4	(3 0 2) 4	(3 1 2) 5	(3 0 2) 4	(3 0 0) 3	(2 0 0) 2		
IV	Heat Transfer	Production Technology-I	Mechanical Measurements	Materials Science and Engineering	Open Elective-1	Advanced Communication and Interpersonal Dynamics	Articulation and Elocution	(16 1 14/12)
	ME408	ME405	ME411	ME410	(3 0 2/0) 4/3	CCT401	CCT202	20/19
	(3 0 2) 4	(3 0 2) 4	(3 1 2) 4	(2 0 0) 2		(3 0 0) 2	(0 0 6) Audit	
V	**Practice School-I (PS1101) – (4 to 6 Weeks Duration) - 4 Credits**							
	Mechanical and Electrical Machines	Theory of Machines	Production Technology-II	Departmental Elective-I / Open Elective-II	Communication and Identity	Management Perspectives		
	ES1108	ME1108	ME1109	4/2	CC1104	IL1101		20/18
	(3 0 2) 4	(3 0 2) 4	(3 0 2) 4		2	2		
VI	Design of Machine Elements	Automobile Engineering	Departmental Elective –II	Open Elective -III	Critical Thinking for Decisions at Workplace	Introduction to IoT		
	ME1110	ME1111	4	4	CC1106	EE1111		20
	(3 0 2) 4	(3 0 2) 4			2	2		
VII	Departmental Elective-III	Departmental Elective-IV	Departmental Elective-V	Open Elective-IV	Minor Project	Automation Project		
	4	4	4	4	PR1103	PR1101		22
					4	2		
VIII	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University							16

Total Credits: 166-169

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B. Tech (ME) (Batch: 2017-2021)

CS1201	Robotic Process Automation	178
EE542	Renewable Energy System	181
PH501	Nanotechnology	186
AS1201	Operations Research	182
AS1202	Advanced Statistics	174
CE1202	Municipal & Urban Engineering	67
Semester-VI		
ME1110	Design of Machine Elements	306
ME1111	Automobile Engineering	308
CC1106	Critical Thinking for Decisions at Workplace	58
EE1111	Introduction to IoT	59
DE-II		
ME1205	Refrigeration and Air Conditioning	312
ME1206	Computer Aided Modeling and Simulation	290
OE-III		
CE1206	Disaster Management	72
AS1203	Optimization Techniques	74
IL1202	Green Energy	76
Semester-VII		
PR1101	Automation Project	
PR1103	Minor Project	62
DE-III/IV/V		
ME1208	Mechanical Vibration	300
ME1201	Internal Combustion Engines	298
ME1209	Modelling of Engineering Materials	302
ME1403	Autodesk CAD-CAM for Manufacturing Specialization	310
ME1402	Introduction to Aeronautical Engineering	289
EE1403	Energy Production, Distribution and Safety	296
ME1203	Power Plant Engineering	316
ME1202	Elements of Stress Analysis	314
OE-IV		
IL1203	Economics and Finance for Engineers	70
Semester-VIII		
PS1102/ PR1105/ PR1104	Practice School-II/ Entrepreneurial Project/ Research Project	63

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
LA101	English Communication Skills	1	0	2	1	3

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others
** The ratio of weightage between Theory and Practical content will be 60%: 40%.

Syllabus (Theory)

UNIT I: Basics of English Grammar, Applied English Grammar and Usage, Paragraph Writing: Definition, Structure of a Paragraph, Construction of a Paragraph, Unity and Coherence, academic essay writing
UNIT II: Definition and Characteristic Features of Effective Communication, Barriers to Communication: Types, Ways to overcome effective communication barriers, miscommunication, know what you want to say
UNIT III: Vocabulary Extension: Roots, Prefixes and Suffixes, Synonyms, Antonyms, Homophones, One Word Substitution, Learning words through Situations
Reading Comprehension: Problems, Types of Reading Skills, Strategies
UNIT IV: Listening Skills: listening for effective information, developing effective listening skills, Self-motivation, Aspiration and Ambitions, Discipline & Time Management, Confidence Building
UNIT V: Phonetics and Spoken English: Sounds of English, Word Accent and Weak Forms in English, Intonation, introducing students to the rules of Word Accent and Weak Forms in English, Art of Condensation: Steps Required, Strategies.

Syllabus (Practical)

1. Tips for inculcating effective communication skills (recorded video)
2. Development of listening skill by showing the real-life speech
3. Vocabulary building
4. Mastering Conversations Skills
5. Practice of different sounds of English language
6. Understanding the proper stress and intonation pattern in English Language
7. Role play and Information gap activities
8. Presentations to provide practice in spoken English
9. Techniques of paragraph development
10. Understanding different strategies of reading
11. Skim and scan a passage in search of specific details
12. Inculcating the skill of content prediction and inference

Textbook(s)

1. John Eastwood, Oxford Practice Grammar Intermediate, New Delhi: OUP, 2012.
2. Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011.

3. Krishna Mohan and N. P. Singh, Speaking English Effectively, New Delhi: Macmillan, 1994
4. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.
5. Norman Lewis, Word Power Made Easy, Delhi: Goyal Saab Publishers and Distributors, 1994.
6. A. J. Thomson and A. V. Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.
7. Asha Kaul, Business Communication, Second Edition, New Delhi: PHI, 2010.
8. Edgar Thorpe and Showick Thorpe, Objective English, 2nd Edition, New Delhi: Pearson Education, 2008.

Web Resource(s)

http://nptel.ac.in/courses/109104031/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
MA102	Calculus and Linear Algebra	3	1	0	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Ter m Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks* *
20	20	50	10	100				

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT I: CALCULUS OF SEVERAL VARIABLES:

Functions of two or more variables, Partial Derivatives, Total derivative, chain Rule, Euler's Theorem, Jacobian and transformation, Applications to errors

UNIT II: INTEGRAL CALCULUS

Solids of revolution: Surface and volume, Multiple Integrals - Double integral: Area, change of order of integration, changing to polar coordinates, Triple Integral

UNIT III: VECTOR FUNCTION AND ITS DERIVATIVES

Vector functions, their derivatives and integration, Arc length and UNIT tangent vector, Curvature and UNIT normal vector, Torsion and UNIT Bi-normal vector, Directional derivative and gradient vectors, Tangent plane, Divergence and curl of a vector field

UNIT IV: VECTOR INTEGRATION

Line integral, flux, work done, circulation, Path independence, potential function and conservative fields, Green's theorem in the plane, Stoke's theorem, Divergence theorem

UNIT V: LINEAR ALGEBRA

Matrices, Rank of a Matrix, System of Linear Algebraic Equations, Linear Independence and Dependence, Eigen Values and Eigen Vectors, Cayley Hamilton Theorem, Vector Spaces and Subspaces, Bases and Dimensions, Coordinates, Linear Transformations

Textbook(s)

1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford.
2. Babu Ram, Engineering Mathematics Part – I, Pearson.
3. B. S. Grewal, Higher Engineering Mathematics, 41st Ed., Khanna Publishers, Delhi, 2011.
4. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Fourth Edition (Student Edition), Jones & Barlett, Viba, New Delhi, 2011
5. Rober Wrede, Spiegel M. R., Schaum's outline of advanced calculus, 3rd edition, Tata Mc-GrawHill, New York, 2011
6. Peter V. O'Neil, Advanced Engineering Mathematics, Seventh Indian Reprint, Cengage Learning, New Delhi, 2011.
7. Kreyszig, E., Advanced Engineering Mathematics, John Willey, Delhi (2011).

Web Resource(s)

http://nptel.ac.in/courses/111106051/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
PH101	Engineering Physics	3	1	2	0	5

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: COHERENCE, INTERFERENCE AND OPTICAL TECHNOLOGY
Introduction to optics, Spatial Coherence, Temporal coherence, Coherence length, Coherence time and ‘Q’ factor for light
Formation of Newton’s rings, Measurement of wavelength of light, Diameter of Newton’s rings
Elementary idea of anti-reflection coating and interference filters

UNIT II: DIFFRACTION
Single slit diffraction, position of maxima / minima and width of central maximum, intensity variation. Construction and theory, Formation of spectra by plane transmission grating, Determination of wavelength of light by plane transmission grating.

UNIT III: POLARIZATION
Plane, circular and elliptically polarized light based on electric (light) vector, Malus law. Quarter and half wave plates, construction, working and use of these in production and detection of plane, circular and elliptically polarized light. Introduction and law of optical rotation, specific rotation and its measurement using the half-shade and bi-quartz device.

UNIT IV: LASER AND FIBRE OPTICS
Theory of Laser Action, Einstein’s Coefficients, Threshold Conditions for Laser Action. Theory, Design, and Applications of He-Ne Laser. Theory of Semiconductor Lasers. Optical Fibre, Numerical Aperture, and Maximum Angle of Acceptance.

UNIT V: QUANTUM MECHANICS
Heisenberg’s Uncertainty Principle, Wave and Particle Duality of Radiation, De-Broglie’s Concept of Matter waves, Quantum Nature of Light, Concept of Compton Effect**,** Concept of Wave Function, Physical interpretation of wave function and its properties**,** Schrödinger’s Wave Equation: Time dependent and time independent cases**,** Particle in one-dimensional box**,** Particle in three-dimensional boxes, Degeneracy.

Syllabus (Practical)

1. To determine the wavelength of sodium light by Newton’s Ring
2. To determine the specific rotation of Glucose (Sugar) solution using a Polarimeter
3. To measure the Numerical Aperture of an Optical Fibre.
4. To determine coherent length and coherent time of laser using He-Ne Laser
5. To determine the height of object with the help of a Sextant.
6. To determine the dispersive power of material of a Prism for Violet Red and Yellow colours of Mercury light with the help of a spectrometer.

7. To study the Charge & Discharge of a condenser and hence determine time constant (Both current and voltage graphs are to be plotted).
8. To study characteristics of G.M. Counting System.
9. To convert a Galvanometer into an ammeter of range 1.5/3 amp and calibrate it.
10. To convert a Galvanometer into a Volt of range 1.5/3 volt and calibrate it.

Textbook(s)

1. Mahesh C. Jain, "Textbook of Engineering Physics", Part I, PHI
2. Mahesh C. Jain, "Textbook of Engineering Physics", Part II, PHI
3. Lab Manuals for Physics

Reference Book(s)

1. Arther Beiser, "Concept of Modern Physics" Tata McGrawHill, New Delhi, 5thedn. 1997.
2. Ajoy Ghatak, "Optics", Tata McGraw Hill, 4thedn
3. Eyvind H Wichman, "Quantum Physics" Tata McGraw Hill, Volume 4
4. Neeraj Mehta, "Applied Physics for Engineers", PHI, I edn. 2011
5. Dattu R Joshi, "Engineering Physics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, I edn. 2010.

Web Resource(s)

http://nptel.ac.in/courses/122107035/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE101	Electrical & Electronics Engineering	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others
**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Basic physical laws, circuit elements, Source Transformation, KVL, KCL, Wye (Y) – Delta (Δ) and Delta (Δ) – Wye (Y) transformations.
UNIT II: Norton, Thevenin, Superposition, Max power transfer Theorem
UNIT III: AC NETWORKS: Fundamental aspects of single-phase ac supply, Sinusoidal Steady State, Real/Reactive Power, Phasor, three phase circuits, Start-delta, Two watt-meter Method, simple circuits, RMS Average value, Transients in R-L, R-C, R-L-C.
UNIT IV: TRANSFORMER & MACHINE: Basics of transformer Faraday and Lenz law, Mutual Inductance, construction, working Principles of Transformers, AC/DC machines.
UNITV: INTRODUCTION TO SEMICONDUCTORS: Defining Insulator, Semiconductor, Conductors. Band gap energy and band formation, elementary idea about semiconductor behavior, conductivity, types of semiconductor, p-type and n-type, working principle, characteristics and applications of Diode and Transistor, Transistor CE, CB, CC configuration.

Syllabus (Practical)

ELECTRICAL LAB

1. Single line diagram of a power system and a distribution sub-station and basic functional study of main components used in power systems.
2. Make house wiring including earthling for 1-phase energy meter, MCB, ceiling fan, tube light, three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring
3. Study the construction and basic working of ceiling fan, single phase induction motor and three phase squirrel cage induction motor. Connect ceiling fan along with regulator and single-phase induction motor through autotransformer to run and vary speed.
4. (a) Basic functional study and connection of moving coil & moving iron ammeters and Voltmeters, dynamometer, wattmeter and energy meter.
   (b) Run a 3-phase squirrel cage induction motor at no load and measure its voltage, current, power and power factor. Reverse the direction of rotation.
5. Study the construction, circuit, working and application of the following lamps:
   (i) Fluorescent lamp, (ii) Sodium vapour lamp, (iii) Mercury vapour lamp, (iv) Halogen lamp and (v) Neon lamp
6. (a) Study the construction and connection of single-phase transformer and autotransformer. Measure input and output voltage and fin turn ratio.

(b) Study the construction of a core type three phase transformer. Perform star and delta Connection on a 3-phase transformer and find relation between line and phase voltage.

ELECTRONICS LAB

1. Identification, testing and applications of resistors, inductors, capacitors, PN-diode, Zener diode,LED, LCD, BJT, FET, UJT, SCR, Photo diode and Photo transistor.
2. (a) Functional study of CRO, analog & digital multi-meters and function / signal generator.
   (b) Study the single-phase half wave and bridge rectifier and effects of filters on waveform.
3. Study the BJT amplifier in common emitter configuration. Measure voltage gain, plot gain frequency response and calculate its bandwidth.
4. (a) Study the construction and basic working of SCR.
   (b) Study the single-phase half wave and bridge controlled rectifier and observe the effect of firing angle on waveform.

Textbook(s)

1. S.N. Singh "Basic Electrical Engineering", Prentice-Hall of India Pvt. Ltd, 2011.
2. J. Millman and C. Halkias, Integrated Electronics, McGraw Hill,2th Edition, 6th Indian Reprint, 2011.
3. B. L. Theraja, "Electrical Technology", Vol.1, S. Chand Publication, New Delhi
4. V. K. Mehta, "Basic Electrical Engineering", S. Chand and Company Ltd., New Delhi

Reference Book(s)

1. T.K. Nagsarkar, M.S. Sukhija," Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.
2. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.

Web Resource(s)

http://nptel.ac.in/courses/108101038/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CM101	Elements of Engineering	2	0	4	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Introduction: Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law

UNIT II: Power Transmission Methods and Devices: Introduction to Power transmission, Belt drive, Rope drive, Chain drive, Pulley, Gear drive, Types of gears, Gear train, Clutches, Types and function of clutches, Types and function of brakes, Power measurement by dynamometer, Types of dynamometers.

UNIT III: Internal Combustion Engines: Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4- stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, and specific fuel consumption.

UNIT IV: Introduction: Branches of Civil Engineering, Scope of Civil Engineering, Role of Civil Engineer in Society. Impact of infrastructural development on economy of country.

Building Materials and Construction**:** Materials: Introduction to construction materials like Stone, Bricks, Lime, Cement, Timber, Sand, Aggregates, Mortar, Concrete and bitumen.

Construction: Classification of buildings, Types of loads acting on buildings, Building components and their functions and nominal dimensions

UNITV: Transportation Engineering: Role of transportation in national development, Modes of transportation, Introduction to road traffic and traffic control, Introduction to mass transportation system.

Syllabus (Practical)

Mechanical Engineering

1. Basics of manufacturing, types of production systems, ethics, safety in workshop.
2. Metrology, quality, Least Count of a measuring Instrument, measurement with Vernier Caliper or Micrometer.
3. Machining – Demonstration of Turning, Step Turning, Facing, etc.
4. Casting – Demonstration of sand-casting process
5. Forging – Demonstration of forging operations
6. Sheet metal working applications.
7. Hands on practice of Sheet metal working operations using hand tools- Preparation of Funnel.
8. Gas Welding, Demonstration of Gas Welding
9. Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Lap Joint model.
10. Mechanical joining processes, Arc Welding

11. Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Butt Joint model.
12. Introduction to wood working, Wood working Tools, Types of wood, Types of joints.
13. Hands on practice of Wood working operations using hand tools- preparation of Lap Tee Joint, Mechanical joining processes, Soldering, Brazing.
14. Machining – Demonstration of Shaping operations
15. Hands on practice of Fitting operations using hand tools- Prepare a job in fitting shop.

Civil Engineering

1. To measure the dimension of a given road, pathway, building and area by chain surveying.
2. Layout preparation on ground of a given drawing using compass and chain.
3. To determine compressive strength of a concrete cube using Compressive Testing Machine (CTM).
4. Measurement of offsets for a building in Chain Surveying.
5. Verification of conservation of energy in a duct based on Bernoulli's theorem
6. Determination of Turbidity, TDS, hardness of a water sample.

Textbook(s)

Elements of Mechanical Engineering

1. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi.
2. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication.
3. Introduction to Engineering Materials by B.K. Agrawal Tata McGrail Publication, New Delhi.

Elements of Civil Engineering

1. Elements of Civil Engineering Author: Dr. R.K. Jain and Dr. P.P. Lodha Publisher: McGraw Hill Education, India Pvt. Ltd.
2. Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, Vikas Publishing House Pvt. Ltd., New Delhi.

Reference Book(s)

1. H S Bawa, "Workshop Practice", TMH, New Delhi, 2nd Edition, 2011.
2. B S Nagendra Parashar and R K Mittal, "Elements of Manufacturing Process", Prentice Hall of India, New Delhi, 2010.
3. B S Raghuwanshi, "A Course in Workshop Technology", Dhanpat Rai & Co., New Delhi, Volume I & II, 2011.
4. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology," Pearson Education (Low-Cost Indian Edition), New Delhi, 4th Edition, 2005.
5. K. Venkata Reddy, "Workshop Practice Manual", BS Publications, Hyderabad,6th Edition, 2011.
6. P. kannaiah and K. L. Narayana, "Engineering Practices Laboratory", SciTech Publications, Chennai, 2006.

Web Resource(s)

http://nptel.ac.in/courses/112105124/

Course code	Course Title									Teaching Scheme				
										L	T	P	S	Credits
CE102	**Engineering Drawing**									**2**	**0**	**2**	**0**	**3**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	**Mid Term Test–II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks****	**Mid Term Test-I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks****
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others
**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Lines, Lettering & Dimension (Sketch Book)
Scales: Representative factor, plain scales, diagonal scales, scale of chords.
Conic sections: Construction of ellipse, parabola, & hyperbola by different methods; Engineering Curves: Cycloid, Epicycloid, Hypocycloid, Involutes, Archimedean and logarithmic spirals.
UNIT II: Projection: Types of projection, orthographic projection, first and third angle projection, (Sketch Book)
Projection of points and straight lines: Line inclined to one plane, inclined with both the plane, methods for determining True Length, true Inclinations, and Traces of straight lines.
UNIT III: Projection of planes and solids: Projection of Planes like circle and polygons in different positions; Projection of right and regular polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.
UNIT IV: Section of Solids: Section of right solids (like Prism, Pyramid, Cylinder and Cone) by normal and inclined planes in different positions; Intersection of cylinders.
Development of Surfaces: Parallel line and radial-line method for right, regular solids.
UNITV: Isometric Projections: Isometric scale, Isometric axes, Isometric Projection of solids from orthographic drawing.
Computer Aided Drafting (CAD): Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders; transformations and editing commands like move, rotate, mirror, array; Draw Toolbar, Object & Modify toolbar; solution of projection problems on CAD.

Syllabus (Practical)
Sketching and drawing of geometries and projections on Sketch Book & on AutoCAD based on above syllabus

Textbook(s)

1. Kulkarni D M, Rastogi A P, Sarkar A K, Engineering Graphics with AutoCAD, PHI Learning Pvt. Ltd., New Delhi, India, Fourth Printing (Revised Edition), 2012.
2. Bhatt N D, Engineering Drawing, Charotar Book Stall, Anand, India.

Reference Book(s)

1. Jolhe D A, Engineering Drawing with an introduction to AutoCAD, TMH, New Delhi, India.

2. Gill P S, Engineering Drawing (Geometrical Drawing), S K Kataria & Sons, Delhi, India
3. Jeyopoovan T.; Engineering drawing & Graphics Using AutoCAD; Vikas publishers.
4. Engineering Drawing, Basant Agarwal & CM Agarwal, Tata McGraw Hill.
5. Shah MB and Rana BC; Engg. drawing; Pearson Education
6. Luzadder WJ and Duff JM; Fundamental of Engg Drawing; PHI
7. Dhananjay A Jolhe; Engg. Drawing an Introduction; Tata McGraw Hill.
8. Visvesvaraya Tech. University; A Premier on Computer Aided Engg drawing; VTU Belgaum
9. Venugopal K.; Engineering Graphics; New Age

Web Resource(s)

http://nptel.ac.in/courses/112103019/

Course code: LA203
Course Title: Creativity and Design Thinking
Teaching Scheme:

L	T	P	S
2	0	0	0

Credits: 2
Course Objective:
It is often said that "Today, thinking is more important than knowing". Opportunities are what we all look for and their counterparts—the problems—are what we should solve in daily lives. Dynamic environment of twenty first century requires more creative skills from citizens than just analytical skills to manage in the ever-changing work environment.
The course is designed to provide an understanding of problem solving with a touch of creative focus in a systemic framework. The students will be introduced to concepts of creative thinking like convergent and divergent thinking, lateral thinking and brain storming. Structured techniques such as 6 thinking hats and mind maps will also be practiced. Students will be expected to work on live projects to come up with creative Jugaad solutions to problems that they see around them. Concepts around creativity such as the Medici Effect will also be discussed in class through book readings.
The sessions will focus on the following key topics:
1. Why do we need to be creative?
2. Fundamentals of Creative Thinking - What is Creativity, Defining the Problem
3. Tools and Techniques of Creative Thinking
4. Creating Intersections for Creativity
5. Frugal Innovation
6. Disruptive Innovation

Grading &Evaluation:
1. Mid-Term Project – 30%
2. Design Thinking Project - 40%
3. Attendance, Class participation & Assignments– 30%

Recommended Books:

Arie Ruttenberg and Shlomo Maital	Cracking the Creativity Code
Frans Johnsson	The Medici Effect
Navi and Jaideep	Jugaad Innovation
Tom Kelly	Creative Confidence

Teaching tools & methodology:
TCS ION online discussion forum
Hands-on activities
Brain teasers and games
Secondary research
Miscellany:
This course will require high level of self-motivation and class participation. Quality of group exercises, while not graded, will be considered for marks on class participation.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
MA202	**Differential Equations and Complex Analysis**	**3**	**1**	**0**	**0**	**4**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	**Mid Term Test–II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks****	**Mid Term Test-I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks****
20	20	50	10	100				

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT I: ORDINARY DIFFERENTIAL EQUATION, Differential equation of first order, Differential equation of higher order with constant coefficients, Differential equation of second order with variable coefficients
UNIT II: PARTIAL DIFFERENTIAL EQUATION, Partial Differential Equations of First Order, Variable separable technique for solving PDE, Boundary value problems: Heat equation, wave equation, Laplace equation
UNIT III: LAPLACE TRANSFORMS Laplace Transform, Applications of Laplace transform in solving differential equations.
UNIT IV: FOURIER TRANSFORM, Fourier transform, Applications of Laplace transform in solving boundary value problems
UNITV: SEQUENCES AND SERIES Sequences, Series, Orthogonal function, Fourier series

Reference Book(s)

1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford.
2. Babu Ram, Engineering Mathematics Part II, Pearson.
3. B. S. Grewal, Higher Engineering Mathematics, 41st Ed., Khanna Publishers, Delhi, 2011.
4. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Fourth Edition (Student Edition), Jones &Barlett, Viba, New Delhi, 2011.
5. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill.
6. Peter V. O'Neil, Advanced Engineering Mathematics, Seventh Indian Reprint, Cengage Learning, New Delhi, 2011.
7. Kreyszig, E., Advanced Engineering Mathematics, John Willey, Delhi (2011).

Web Resource(s)

http://nptel.ac.in/courses/122107037/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CH101	**Engineering Chemistry**	**3**	**1**	**2**	**0**	**5**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Water Chemistry, Introduction, common Impurities in water, Hardness of water, Determination of hardness by Clark's test and complexometric (EDTA) method. Removal of hardness by Lime Soda, Zeolite and Ion exchange process.
Boiler feed water troubles their causes, disadvantages and prevention, Scale & Sludge Carry over (Priming and Foaming), Boiler Corrosion and Caustic embrittlement.
UNIT II: POLYMERS, Introduction to Polymer, Classification of polymers. Methods of Polymerization, Plastics: Thermosets and Thermoplastic. Preparation, properties and uses of Vinyl resins, Bakelite, Polyesters and Nylons. Rubbers: Natural rubber, vulcanization, synthetic rubbers e.g., Buna-S, Buna-N, Butyl, Thiokol and Neoprene rubbers.
UNIT III: Corrosion & Lubricants, Definition and its significance, Theories of corrosion: Dry corrosion theory, Wet (Electrochemical) theory, Passivity, Types of electrochemical corrosion. Factors influencing rate of corrosion. Introduction, classification, and uses of lubricants. Types of lubrication. Viscosity & viscosity index, Flash point Fire point, cloud and pour point, steam emulsification number, precipitation number and neutralization number.
UNIT IV: SOLID STATE CHEMISTRY, Solid State, Types of solids, Space Lattice and UNIT cell, Types of UNIT cell, Cubic System – Number of atoms per UNIT cell, Atomic Radius, Density Calculation of UNIT cell. Bragg's Law X-ray studies of Crystals.
Graphite – Structure, Properties and applications.
Liquid Crystal: Liquid Crystalline state, Classification of liquid crystal and their applications.
UNITV: ENGINEERING MATERIALS, Cement: Definition, Composition basic constituents and their significance, manufacturing of Portland cement by Rotary Klin technology. Setting and hardening of cement and role of gypsum.
Nanotechnology and Nano materials: Fullerenes and Carbon Nano tubes - Introduction, Structural properties, preparation and their applications.

Syllabus (Practical)

1. To determine the hardness of water by complex metric method using EDTA.
2. To determine the strength of NaOH and Na_2CO_3 in given alkali mixture.
3. To determine the strength of copper sulphate with the help of Hypo solution.
4. Measurement of conductivity of given sample by conductivity meter.
5. Measurement of pH of given sample by pH meter.
6. Determination of Barium as barium sulphate gravimetrically.

7. Measurement of Fluoride in water sample.
8. Determination of Na/K/Ca by Flame photometer in each sample.
9. To determine the amount of free chlorine in given sample.
10. To determine the viscosity of a given sample of lubricant oil at various temperature.
11. To determine flash and fire point of a given lubricant using Pensky-Martin's apparatus.
12. Measurement of Nitrate and Oxygen in water sample.
13. To determine cloud and pour point of a given sample of lubricating oil using Cloud and Pour point apparatus.

Textbook(s)

Engineering Chemistry by Jain & Jain (Dhanpat Rai publication)

Reference Book(s)

1. Engineering Chemistry by B Sivasankar, (Mc-Graw Hill publication).
2. Engineering Chemistry by O.G. Palanna, (Mc-Graw Hill publication).
3. Engineering Chemistry (Wiley India publication).
4. Introduction to Nanotechnology by Poole Owens (Wiley)
5. Nanotechnology by Shah & Shah (Wiley)
6. *Chemistry* in *Engineering*& Technology by J. C. Kuriacose and J. *Rajaram*, Vol. 1&2
7. The Physics and Chemistry of Solids by Elliott (Wiley)
8. Engineering Chemistry (Wiley India publication).
9. Polymer Chemistry by Stevens (Oxford)
10. Polymer Science and Technology by Ghosh (Tata Mc-Graw Hill publication)
11. Polymer Science and Technology by Fried (PHI publication)
12. Textbook of Polymer Science by Billmeyer (Wiley)

Web Resource(s)

http://www.nptel.ac.in/courses/122106028/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ID201	Environmental Studies	2	0	0	0	2

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100				

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT I: Understanding environment, The global crisis, Basic Concepts, Forest and Grassland ecosystems, Desert Ecosystems, Aquatic Ecosystems
UNIT II: Introduction to Biodiversity, Biodiversity Conservation. Water Resources, Energy Resources, Forest Resources
UNIT III: Land, Food, and Mineral Resources, Air and Noise Pollution, Water, Soil, and Marine Pollution
UNIT IV: Solid Waste Management and Disaster Management, Population Growth, Environment and Human Health, Sustainable Development
UNIT V: Global Warming, Acid Rain, and Ozone Depletion, Different types of laws and regulations

Textbook(s)

1. Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford University Press, New Delhi, 2e, 2011

Reference Book(s)

1. Ranjit Daniels & J. Krishnaswamy "Environmental Studies", Wiley India
2. Davis & Cornwell "Environmental Engineering", Mc Graw Hill

Web Resource(s)

http://www.nptel.ac.in/courses/120108004/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME201	**Engineering Mechanics**	**3**	**1**	**0**	**0**	**4**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100				

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT I: Fundamentals of engineering mechanics, Laws of Motion, Equilibrium, Conditions for equilibrium, and Equations of equilibrium. **Statics of Particles and Rigid Bodies:** System of forces, Resultant force, Resolution of force, Moment and Couples.

UNIT II: Trusses: Truss analysis, analysis of frames and machines. **Friction:** Types of Friction, Laws of friction, Angle of friction, Angle of repose, Applications of Friction. **Lifting Machines:** Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of Pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel.

UNIT III: Properties of Plane Surfaces: Centroids & Centre of Mass, area of moments, principle moments of inertia, Second moment of mass. **Kinetics of Particles and Rigid Bodies**: Equation of motion in rectangular coordinate, radial and transverse components, Equation of motion in plane for a rigid body. **Impulse and Momentum:** Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body.

UNIT IV: Virtual work: Principle of Virtual Work, Active forces and active force diagram.

Kinematics of Particles and Rigid Bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectile's motion on plane and Inclined Plane, Relative Motion.

UNIT V: Work, Energy and Power: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy.

Textbook(s)

1. Meriam and Kraige, **"Engineering Mechanics-STATICS"**, John Wiley & Sons, Fifth Edition, 2010
2. Meriam and Kraige, **"Engineering Mechanics-DYNAMICS"**, John Wiley & Sons, Fifth Edition, 2010

Reference Book(s)

1. Engineering Mechanics, Basudeb Bhattacharyya, Oxford University Press
2. Vector Mechanics for Engineers, Beer and Johnston, Tata McGraw-Hill., Ninth Edition, 2009.
3. Engineering Mechanics, Hibbeler, Pearson Education, Sixth Edition, 2010
4. Engineering Mechanics, Andrew Pytel & Kiusalas, Cengage Learning, Third Edition, 2010.
5. Engineering Mechanics, Timoshenko and Young, Tata McGraw-Hill, Fourth Edition, 2006.
6. Engineering Mechanics-Statics and Dynamics, Shames, Pearson Education.
7. Engineering Mechanics, Boresi and Schmidt, CL-Engineering, First Edition, 2008.

Web Resource(s)

http://nptel.ac.in/courses/122104015/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CSE202	Object Oriented Programming	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	Mid Term Test–II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**	Mid Term Test-I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	40	40	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Identifiers and constants (Literals), Keywords, Data Types, The Operators, New Casting Operators, Typeid and throw, The Conditional structures and Looping Constructs

UNIT II: Difference between Struct and class in C++, the difference between Union and Class, Static Data members of a class, Pointer to objects and pointer to members of class, The local classes, Assigning Objects

UNIT III: Introduction to Functions, The Inline function, Default Arguments to the function, Functions with object as parameters, call by reference and return by reference, Prototyping and Overloading, Friend functions, Const and Volatile functions, Static functions, Private and Public functions

UNIT IV: Introduction to constructors, the explicit constructors, Parameterized constructors, Multiple constructors, Constructors with default arguments, Dynamic Initialization, Constructor with dynamic allocation, copy constructors, The member initialization list, destructors

UNIT V: Overloading Operators, the need, defining derived class using single base class, Derivation using public, private and protected access modifiers

UNIT VI: The implementation of Inheritance in the C++ object model, multiple-inheritance, Abstract classes, Composite objects (container objects), Compile Time and Runtime Polymorphism Introduction, Need for Exception handling, Components of exception handling mechanism

Syllabus (Practical)

Programs using C++/Java which covers following concepts:

1. Declaration and Usage of Classes and Objects
2. Constructors and Destructors.
3. Overloaded Functions and Overloaded Operators.
4. Inheritance
5. Exception handling mechanism.

Textbook(s)

1. Object Oriented Programming with C++, E. Balagurusamy, McGraw Hill, 2013.
2. Object Oriented Programming with Java, RajkumarBuyya, McGraw Hill, 2014.
3. Object Oriented Programming in C++, Robert LaforeTechmedia Publication, 2005.
4. Mastering in C++, RajkumatBuyya, McGraw Hill, 2014.
5. Let us C++, Yashavant P. Kanetkar, BPB Publications, 2003

Reference Book(s)

1. Programming with ANSI C++ by Bhushan Trivedi, Oxford University Press, 2012.
2. An Introduction to Object Oriented Programming with Java, C Thomas WU, Fourth Edition, Tata McGraw Hill, 2005.
3. An Introduction to Object-Oriented Programming, 3rd Edition, Timothy Budd, Pearson, 2001.
4. C++: The Complete Reference, 4th Edition, Herbert Schildt, McGraw Hill Education, 2003.

Web Resources

http://nptel.ac.in/courses/106103115/36

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credit</td></tr>
<tr><td>LA204</td><td>Introduction to Critical Thinking</td><td>2</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table>

Course Description

This course is intended to introduce critical thinking.

Critical thinking provides the foundation for important skills such as rational decision-making and effective problem solving and is a key competency for success in the modern workplace. A domain general skill, critical thinking enhances verbal and written communication, presentation, and creativity, leading to success in academics and professional life.

The primary aim of the course is to enable students to analyze, reason and evaluate situations, text and information sources more carefully. The course will encourage them to read and think deeply, ask insightful questions and develop the ability to see how things connect and interact.

The course will introduce students to the concepts of bias, fallacies, fact, opinion, assertion and argument. It will enable them to differentiate one from another, and to train their minds to interpret information more efficiently and effectively. It will also introduce students to multiple disciplinary perspectives and show them how to engage critically with differing viewpoints.

Through group exercises, class discussions, word/logic games and film screenings, the course will use a variety of tools and frameworks that make critical thinking a habit, inside and outside the classroom.

The sessions will focus on the following key topics:

1. Introducing assertion and argument
2. Separating fact from opinion
3. Reconciling multiple sources
4. Understanding biases and assumptions
5. Recognizing multiple perspectives

Grading

The following is approximately how the final grade will be determined--changes will only occur in exceptional situations:

1. Response paper 1 .... 40%
2. Response paper 2 .... 40%
3. Class participation 20%

Recommended Online Courses

1. Critical Thinking Skills for University Success – Coursera
2. Reasoning Across the Disciplines - Coursera

Teaching tools & methodology:

TCS ION online discussion forum

Games and workshop activities

Brain teasers and puzzles

Peer reviews

Miscellany:

This course will require high level of self-motivation and class participation. Quality of group exercises, while not graded, will be considered for marks on class participation.

<table>
<tr><th rowspan="2" colspan="2">Course code</th><th rowspan="2" colspan="4">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="2">CE305</td><td colspan="4">Structure Analysis-I</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
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<table>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test - II</th><th>End Term Test</th><th>Class Participation / Additional Continuous Evaluation*</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th>Class Participation / Additional Continuous Evaluation*</th><th>Total Marks</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Basics of Strength of Materials - Types of stresses and strains, Definition of determinate and indeterminate structure, Degree of Freedom, Free Body Diagram, Concept of stress and strain, Mohr's circle of stress and strain, Principle stress and strain examples, Strain – strain relationship, Hook's law, Elastic constants & relation between them, Concept of Principle Axes, Moment of Inertia & Centre of Gravity, Compound and composite bars

Bending Moment and Shear Force – Introduction to bending moment and shear force diagram in beam, simply supported beams, overhanging beams, Beam with varying distributed load, Bending Moment and Shear Force for inclined loading

Concept of Bending & Shear Stresses – Flexural formula, Stress – Strain diagram for beam, Shear stress in beam, Shear stress in beam with different cross-section

Concept of Torsion - Torsion in circular shaft, Torsion Equation, Shear stress in shaft due to torsion, Combined Bending & Torsion

Concept of Slope and Deflection – Introduction to slope and deflection in beam by differential equation, Double Integration method, Moment area method (Mohr's Theorems), Conjugate beam method, Strain Energy Method, Macaulay's method, Maxwell's reciprocal deflection theorem, Betti's theorem of reciprocal deflections, Examples, **Combined Direct & Bending Stresses**

Textbooks:

1. Pytel, A., and Jaan Kiusalaas, "Mechanics of Materials", CL Engineering,2nd edition, 2011
2. Hibbeler, R.C., "Mechanics of Materials SI", 6th SI edition, Prentice Hall
3. Ryder, G.H., "Strength of Materials", Palgrave Macmillan, 1969

Reference Books:

1. Beer, F.P., Johnston, E.R., DeWolf, J.T., "Mechanics of Materials", McGraw Hill, 4th edition,
2. Craig, R.R., "Mechanics of Materials", John Wiley and Sons, 2nd edition, 1999
3. Singh, Sadhu, "Strength of Materials - I", Khanna Book Publishing, Latest edition
4. Rattan, S.S., "Strength of Materials", McGraw Hill, New Delhi, 2nd edition

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
CE306	**Fluid Mechanics**	**3**	**1**	**2**	**0**	**5**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	**Mid Term Test - II**	**End Term Test**	**Class Participation / Additional Continuous Evaluation***	**Total Marks**	**Mid Term Test - I**	**End Term Test**	**Class Participation / Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

Unit-I: Introduction: Fluid and continuum, Physical properties of fluids, Rheology of fluids. **Kinematics of Fluid flow:** Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, subcritical, critical and supercritical flows-, one-, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body.
Unit-II: Fluid Statics: Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. **Dynamics of Fluid Flow:** Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its Application to pipe bends.
Unit-III: Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.
Unit-IV: Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.
Unit-V: Boundary Layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub layer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder.

Syllabus (Practical)

1. Determination of viscosity of oil
2. Establish relationship between pressure and height
3. Determination of metacentre of a floating body
4. Verification of conservation of energy in a duct based on Bernouli's theorem
5. Calibration of venturimeter, orificemeter, pitot tube and rotameter
6. Determination of coefficient of friction in close conduit as major losses

7. Determination of minor losses from bend, elbow, sudden contraction, enlargement
8. Lab exercises using Bentley WaterGEMS v8i.

Reference Books:

1. S Narasimhan: First Course in Fluid Mechanics, University Press
2. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
3. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
4. S. K. Agarwal: Fluid Mechanics & Machinery, TMH
5. Garde, R.J., "Fluid Mechanics through Problems", New Age International Pvt. Ltd, New Delhi, 2nd Edition.
6. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. 1946
7. I. H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student, Education, 1988.
8. Vijay Gupta and S. K. Gupta, "Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.
9. Modi, P.N., and Seth, S.H., "Hydraulics and Fluid Machines", Standard Book, House, 1989.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CE308	**Surveying**	**3**	**0**	**2**	**0**	**4**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

Unit 1: Basic principles, Maps, Topographic Sheets, their scales and uses; Classification of surveys; Linear measurements using chains and tapes, chaining and ranging, principles of chain surveying. Principles of compass survey, Measurement of bearing, whole circle bearings & quadrant bearings, fore bearing and back bearing, Computation of angles from bearings, Plane table survey.

Unit 2: Automatic levels, booking and reducing levels, simple and differential leveling, profile and cross-section leveling, reciprocal leveling, methods of leveling. Contouring: definition, contour interval, characteristics of contours, direct and indirect methods of contouring, interpolation of contours, uses of contour maps, Theodolite, temporary and permanent adjustments, measurement of horizontal and vertical angles.

Unit-3: Modern surveying electronic equipment: digital levels, digital theodolites, EDMs, Total stations; Principles, working and applications; Lasers in surveying.
Total Station: Components Used in Total Station Surveying, functioning and measurements, Slope Staking, Topographic surveys, Construction project layout: building corners, control and offset lines, Leveling, Traverse surveys and adjustments, Building Face Surveys, Resections, Road (Highway) Surveys.

Unit 4: Global Positioning System: Basic of GPS, Positioning using Satellites, GPS Principles, GPS receivers, GPS Errors and Accuracy, Error sources in GPS observations, References-Global Positioning System, Satellite geometry and Accuracy measures, GPS Measurements Techniques, GPS Algorithms/Navigational Solutions, Other Satellite navigation Systems and GPS Modernization.

Syllabus (Practical)

1. Measurement of offsets for a building
2. Tape and compass traverse survey for a boundary line
3. Simple leveling and measurement of gradients
4. Profile leveling and cross-section leveling for a road line
5. Preparation of a contour sheet for an area
6. Plane table surveying for a land area, traffic junction
7. Measurement of horizontal and vertical angles.
8. Quantity Surveying (Area and Volume Measurement),

9. Field project using total station

Text and References Books:

1. Plain Surveying, AM Chandra, New Age International Publishers
2. Surveying Vol-I, BC Punamia, AK Jain, AK Jain, Laxmi Publishing G. Strang, Linear algebra and its applications (4rh Ed.), Thomson (2006).
3. Surveying and leveling by Subramanian, Oxford Publication.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
MA302	Computer Based Numerical and Statistical Techniques	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT – I: Numerical Methods – I: Modeling and Error Analysis, Solutions to transcendental and polynomial equations, Solutions to system of linear simultaneous equations

UNIT – II: Numerical Methods – II: Interpolation and approximation, Numerical Differentiation and Integration, Solutions to Ordinary Differential Equations

UNIT – III: Basic Statistics: Introduction to probability, Discrete and continuous random variables, Probability Distributions: Binomial, Possion and Normal distributions, Mathematical expectation, Correlation and Regression

UNIT – IV: Sampling Distributions and Estimation: Sampling, Types of sampling, sampling errors, sampling distribution of means, variance and proportions for normal population, The Central Limit Theorem, Chi-Square, t and F distributions, Estimators, Point and interval estimation

UNIT – V: Test of Hypothesis: Null and alternative hypotheses, the critical and acceptance regions, two types of error, Parametric Tests, Chi-square goodness of fit test, Contingency tables

Syllabus (Practical)

Numerical Methods using MATLAB and Statistical Analysis using SPSS in Computer Labs that includes:

1. Numerical solution of algebraic and transcendental equations.
2. Numerical solution of system of linear equations.
3. Interpolation.
4. Numerical differentiation.
5. Numerical integration.
6. Numerical solution of differential equations.
7. Data Analysis using Correlation and Regression
8. Test of Hypothesis

Textbooks and Reference books

1. Srimanta Pal, Numerical Methods: Principles, Analyses and Algorithms, Oxford University Press, New Delhi.
2. Rishard A. Johnson, Miller and Freund's probability and Statistics for Engineers, PHI, 8th Ed.
3. K. E. Atkinson, Introduction to Numerical Analysis, John Wiley and Sons.

4. M.K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International publishers, New Delhi.
5. Steven C Chapra, Raymond P Canale, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3rd Editions, Tata Mc Graw Hill, New Delhi, 2012.
6. Cheney and Kincaid, Numerical Methods and Applications, Cengage Publications, New Delhi.
7. Cleve B. Moler, Numerical Computing with MATLAB, Prentice Hall of India, New Delhi.
8. Ravichandran J., Probaility and statistics for Engineers, Wiley India, New Delhi.
9. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition (2004).
10. Prem S. Mann, Introductory Statistics, Wiley publication, 7th edition.

Course Title and Code: Effective Communication Design: CCT306		
Course Description: The course deals with written and verbal communication skills. Students will learn structuring their pieces of communication using various principles of effective communications. By the end of this course, the students will be able to articulate and present effective pieces of communication in the form of e-mails, monologues, presentations (small and long)		
Course Course outcomes CCT306.1. Explain the principles of Effective Communication Design CCT306.2. Apply the principles for structuring and designing written and oral communication. CCT306.3. Reason and Prioritize the content of presentation and emails CCT306.4. Demonstrate improvement in speak-listen- feedback		
Hours per Week		**L-T-P: 3-0-0**
Planned hours		**30**
Actual hours		
Credits		**3**
Sr. No	**Specifications**	**Marks**
01	Attendance	10
02	Assignment	70
03	Class Participation	20
	Total (100)	**100**

Syllabus of the Course

Topics	Content
Introduction to principles of effective communication design	• Beginning-Middle-End • Pyramid Principle-Governing Thought • KISS Principle • Power of Three
E-mail writing	• E-mail etiquette • Analyzing good and bad examples of e-mails
Written Communication	• Practicing structure and summary • Applying principles of effective communication through various assignments
Flowchart and Mind Mapping	• Practicing putting thoughts in sequence • Speak-Listen-Feedback
Verbal Communication	• Important parameters to make oral presentation effective oral presentation. a. Delivery and Body Language b. Delivery-Voice c. Content • Audience analysis • Applying the principles of effective communication
Planning for presentation	• Essential elements of power point presentation • Common mistakes made in Power point presentation

Course Title and Code		
Intelligent Machines (AI, Robotics, IoT): ID303		
Course Description This course introduces an understanding of the fundamental concepts of Artificial Intelligence and Machine Learning, Internet of Things and Robotics. Focus of this course would be on discussion of case studies on various aspects.		
Prerequisites		**Basic Programming Course**
Hours per Week		**L-T-P: 2-0-0**
Credits		**2**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	40
03	Class Participation	20
04	Quiz	40
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam (Final)	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2(Final)	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

IoT: Introduction to Embedded IOT System: Interfacing sensors and motor, Controlling Devices and Reading input Status from sensors using webpage, Introduction to API and web services, Designing SMS API and security OTP app, Camera Interfacing using sensors, Basic SMTP protocol and Mail server and Sending Mail (Security application) mail based, Creating applications with weather updates.
Artificial Intelligence and Machine Learning: Understanding what we mean when we say machines think, how does AI relate to the rest of predictive analytics, How AI works and its inherent limitations., AI till date, Expectations from the field of AI, Introduction to Machine Learning, Preprocessing your data, Regression model, Classification model, Clustering Model, Case-study-Water Jug Problem, Titanic Data Set

Robotics: Elements of robots: joints, links, actuators, and sensors. Position and orientation of a rigid body, Representation of joints, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, purpose of sensors, internal and external sensors, common sensors, Kinematics of serial robots, Degrees-of-freedom of parallel mechanisms and manipulators.

Reference / Textbooks

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education, 2003.

4. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education, 2002.
5. David Poole, Alan Mackworth, Randy Goebel,” Computational Intelligence: a logical approach”, Oxford University Press, 2004.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CE405	Structure Analysis-II	3	1	0	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks**
20	20	50	10	100	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Unit 1: Analysis of indeterminate beams & frames: Static determinacy and indeterminacy, strain energy and energy theorems – theorem of minimum potential energy, principle of virtual work, castigliano theorem, betti's law, clerk maxwell's reciprocal theorem, Force Method, displacement method, Three Moment Theorem, Column Analogy Method, moment distribution method.
Unit 2; Analysis of trusses: indeterminate truss by force method, displacement method
Unit 3: Analysis of arches: three hinged arches (determinate) and two hinged arches (indeterminate)
Unit 4: Columns and Struts - Definitions, Classifications, Assumptions made in the Euler's Column Theory, Expressions for crippling load of different cases like both the ends are hinged or pinned, one end is fixed and other is free, both ends are fixed, one end is fixed other is hinged, Effective length of column, Slenderness ratio, Crippling stress in terms of Effective length and radius of gyration, limitations of Euler's Formula, Rankine's Formula, Eccentric loading, Johnson's Formula for Columns, both straight line and parabolic formula for columns, Examples .

Reference Books:

1. Yuan Yu Hsieh (1987) Elementary Theory of Structures, 3rd edition, Prentice Hall.
2. Ghali, A., Neville, A. M., Structural Analysis (Unified Classical and Matrix Approach), Chapman and Hall Ltd.
3. Menon, Devdas (2008) Structural Analysis Structural Analysis, Narosa Publishing House Narosa Publishing House Pvt. Ltd., New Delhi.
4. Menon, Devdas (2009) Advanced Structural Analysis, Narosa Publishing House, New Delhi. House, New Delhi.
5. R. C. Hibbeller (2002), Structural Analysis, 5th ed, Pearson Education.
6. J. Mc Carmac and R. E. Elling, Structural Analysis: A classical and Matrix Approach, Harper and Row Publishers.

Course Code and Name: CE402 Engineering Geology and Building Construction
Teaching Scheme: 3 0 2 0
Credit: 4
Course Outcomes:
On successful completion of this course students will be able to:

- CE402.1. Apply the geological concepts for the Civil Engineering applications.
- CE402.2. Identify and classify common minerals, rocks and soils, and understand their significance to different types of engineering projects.
- CE402.3. Analyze the possible geological problems to evaluate sites for the construction of Dam, Tunnel and Bridges.
- CE402.4. Analyze the effect of weathering phenomenon on civil engineering works.
- CE402.5. Plan precautions against faulting, folding, bedding planes, joints, cracks, fissures etc. and permeability and ground water conditions
- CE402.6. Understand the components of a building and their functions,
- CE402.7. Select appropriate building materials required for building construction as per IS Code.
- CE402.8. Incorporate principles of sustainability in making building construction decisions that conserve natural resources.

Syllabus (Theory)
Part 1: Engineering Geology
Unit I-Earth Sciences: Introduction,
Basics of Engineering Geology: Scope of Engineering Geology for a Civil Engineer
Types of Geology: Physical geology and mineralogy
Unit II- Petrology: Classification of rocks and their uses as building and road materials
Failures in Earth crust: Historical geology; Structural geology: Folds, faults, unconformity etc.
Unit III-Investigation in Geology: Engineering geology: Geological investigations at dam, tunnel and bridge sites and influence of various structures
Precautions in different earth planes: Precautions against faulting, folding, bedding planes, joints, cracks, fissures, permeability and ground water condition.
Part 2: Building Construction and Materials
Unit IV Components of a building and their functions, foundation, shallow and deep foundation, grillage, raft, inverted arches, causes of failure of foundations and remedial measures, Masonry: types**-** Bricks and stone masonry, functions, material requirements, different bonds, damp proofing course
Unit V Shoring, under pining, scaffolding, horizontal and vertical shores, purpose and methods of under pinning, different types of scaffolding, floors and roofs: types, details of construction and materials
Unit VI Doors: paneled, glazed, flushed doors, collapsible steel doors, Windows: Casement, Sash, and Skylight windows, Staircase: Requirement of a good staircase, different types of staircases
Unit VII Physical and chemical characteristic of commonly used building materials in Civil Engineering construction – Clay, Sand, Stone, Lime, Cement, Concrete, Bricks, Silica, Aluminum and Timber with reference to its specifications. Plywood, asbestos, plastics and polymer-based materials.
Syllabus (Practical)

1. Megascopic study of minerals
2. Megascopic study: Igneous, Sedimentary, Metamorphic
3. Understand fold and faults within a rock mass
4. Study geological features of rocks such as strike and dip
5. Soil erosion and physical weathering in the rocks
6. Structural analysis using stereo nets or Wulff's net
7. Geological maps representing the geological structure of some segment
8. Use of GPS instrument for geological data generation.

Evaluation Scheme:

Prerequisites		A Basic Civil Engineering Materials Course
Teaching Scheme (Hours per Week)		L T P: 3 0 2
Credits		4
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	20
8	Report-I	5
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	20
16	Course Portfolio	NIL
	Total (100)	100

Textbook(s)

1. Prof. Prabin Singh, 'Engineering & General Geology" S K Kataria & Sons, 8th edition, 2008
2. Principles of Engineering Geology, Bangar
3. B.C. Punmia, "Building Construction", Laxmi Publications Pvt. Ltd.
4. Sushil Kumar, Building Construction, Standard Publishers, Delhi.

Reference Book(s)

1. Structural Geology by Billings
2. Petrology by Tyrll
3. Surendra Singh, Engineering Materials, Konark Publishers Pvt. Ltd.
4. D.S. Arora, 'Text Book of Engineering Materials', Kalyani Publishers
5. Building Planning and Drawing by Dr. N. Kumara Swamy, A. Kameshwara Rao, Charotar Publishing House Pvt. Ltd.

Video Links:

https://nptel.ac.in/courses/105105106/
https://youtube.com/results?search_query=engineering+geology++lectures+for+civil+engineering

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CE409	**Concrete Technology**	**3**	**0**	**2**	**0**	**4**

Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Course Syllabi (Theory):

Review of constituent materials – Cement, Aggregates and mix design, admixtures,
Properties of concrete in fresh and hardened state, special concretes, durability of concrete subjected to extreme environment,
Deterioration mechanisms, assessment and control of corrosion in concrete structures,
In-situ assessment of concrete structures,
Various NDT techniques and their applications, Repair of concrete structures

Syllabus (Practical)

1. Tests on cement – specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes
2. Tests on fine aggregate – specific gravity, bulking, sieve analysis, fineness modules, moisture content, bulk density and deleterious materials.
3. Tests on coarse aggregate - specific gravity, sieve analysis, fineness modulus, bulk density.
4. Tests on Fresh Concrete: Workability: Slump, Compaction factor tests, Flow table test.
5. Indian standard method of test for permeability of cement mortar and concrete.
6. Hardened Concrete: Compressive strength on Cubes, Static modulus of elasticity, Flexure tests, Nondestructive testing
7. Mix Design of Concrete.

Textbook(s)/ Reference Book(s)

1. Neville, A.M. and Brooks, J.J.," CONCRETE TECHNOLOGY", ELBS .1990.
2. Mehta, P.K., "CONCRETE Structure, Material and Properties" Prantice Hall Inc.1986.
3. Newman, K., "CONCRETE SYSTEMS in COMPOSITE MATERIALS”. EDT BY L.Holliday. Elsevier Publishing Company. 1966.
4. Powers, T.C., "THE PROPERTIES OF FRESH CONCRETE”. JOHN WILEY & SONS, INC. 1968.

Course Code and Name: CE 403 Hydraulic Engineering
Teaching Scheme: 3 0 2 0
Credit: 4

Course Outcomes
After course completion, the student will be able to:

CE403.1. Explain the principles governing the open channel flow.
CE403.2. Classify the various types of flow in open channels.
CE403.3. Design the most efficient cross section of channel for uniform flow.
CE403.4. Compute the gradually varied flow profiles in prismatic and non-prismatic channels.
CE403.5. Analyze the flow in channels by open source software HEC RAS.
CE403.6. Compute the rapidly varied flow profile (hydraulic jump) in open channels.
CE403.7. Explain the basic equations and principles of unsteady flow in open channel.
CE403.8. Explain the principles governing the flow in rivers and canals with sediments.
CE403.9. Explain the various forms of river.
CE403.10. Explain the various sources of water in rivers.
CE403.11. Design the canals with and without sediments with IS standards.

Syllabus (Theory)

Unit 1: Basic Principles: open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows.
Unit 2: Uniform flow, roughness coefficient, computation of uniform flow in prismatic channel, design of non- erodible channels for uniform flow, Most efficient channel section, compound sections
Unit 3: Gradually varied flow: Theory and analysis, gradually varied flow computations in prismatic channels, gradually varied flow in non-prismatic channels. Rapidly varied flow: Theory of hydraulic jump, evaluation of jump elements in rectangular and non-rectangular channel, location of jump on horizontal floor, channel controls and transitions, free over fall, thin plate weirs, broad crested weirs, and sluice gates.
Unit 4: Unsteady flow in open channels, surge movement in open channels, Numerical methods to solve Saint-Venant Equation
Unit 5 River regions and their characteristics - classification of rivers on alluvial plains - meandering of rivers, design of canals with sediments

Syllabus (Practical)

1. Calibration of triangular notch for field installation
2. Study on velocity distribution in an open channel
3. Study phenomena of hydraulic jump
4. Study on critical depth of flow
5. To perform the Reynolds experiment for determination of different regimes of flow.
6. To study the movement of surge in open channel
7. To study the sediment movement in channels

Course Evaluation for Hydraulic Engineering

Prerequisites		Fluid Mechanics
Teaching Scheme (Hours per Week)		3 0 2
Credits		4
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment	5
3	Class Participation	5
4	Quiz	NIL
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	40
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	20
16	Course Portfolio	NIL
	Total (100)	100

Text /References Books:

1. V.L. Streeter, “Fluid Mechanics”, Mc Graw-Hill, N.Y, USA.
2. 2.R.J. Garde “Fluid Mechanics” RPH, Roorkee.
3. Shames, “Mechanics of fluids”, Mc Graw-Hill (Int. St. ed.) Auckland, NZ
4. A.K. Jain “Mechanics of fluids”, Khanna Publisher., Delhi
5. Subramanya, “Flow in Open channels”
6. K G Ranga Raju, “Flow through open channel”
7. V.T Chow “Open channel Hydraulics”
8. Bakhmeteff, “Hydraulics of open channel”
9. Henderson, “Open channel flow”

Course Title and Code - Advanced Communication & Interpersonal Dynamics| CCT401		
Course Description In this course student will be able to prepare for various group settings, manage difficult conversations, identify individual differences and opinions. This course will enable students to resolve interpersonal conflict by identifying possible sources of conflict and by using a range of techniques to bring about a solution. **Course Outcomes** The students will be able to: CCT401.1. Formulate effective questions, differentiate facts from opinions. CCT401.2. Identify reasons for individual differences and their impact on the group dynamics. CCT401.3. Use inquiry and advocacy to engage with groups. CCT401.4. Identify possible sources of conflict and by using a range of techniques to bring about a solution. CCT401.5. Use and compare different problem-solving techniques to produce the best possible outcome from the group.		
Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-0-0**
Credits		**2**
Sr. No	**Specifications**	**Marks**
1	Attendance	10
2	Assignment(s)	30
3	Class Participation	10
4	Theory Exam	25
5	Project -1	10
6	Project -2	15
	Total	**100**

Syllabus

I. **Introduction to Critical Thinking -** Critical thinking is the ability to think for one's self and reliably and responsibly make those decisions that affect one's life. Students will practice the formulating open-ended, inquiring questions, using available information differentiating facts from opinions, backing their claims with reasons, and thinking from many perspectives

II. **Introduction to Personality, Perception and Learning as source of differences in individual and groups -**Students will be able to understand the relevance of personality, perceptions and learning in a group and their impact on the group dynamics. Introduction to the stages of group development (forming, norming, storming and performing).

III. **Emotional Intelligence and Conflict Resolution Techniques -** Four quadrants of EI- Self-aware, manage their reaction, understand social dynamics and manage Relationships will be discussed. Through the Thomas Killman Conflict Mode Instrument, students will learn about the process of conflict resolution. Techniques for managing conflict. Deep listening will be covered in this module for effective use of the techniques.

IV. **Difficult Conversation using Inquiry & Advocacy –** Concept of silence (Masking, Avoiding, Withdrawing) and violence (Controlling, Labeling, Attacking) . Students will be able to use techniques of inquiry and advocacy to engage with groups. They will be able to gain leverage for improving conversations by paying attention to advocacy and inquiry. They will be exposed to effects of high-low advocacy and inquiry.

V. **Empathy & Feedback-** Concept of empathy will be discussed. The requirements/prerequisites for Empathy ((Open-mindedness, imagination, Knowing and accepting yourself). Introduction to the concept of Giving & Receiving Feedback.

VI. **Problem solving techniques in a Group-** Concept of brainstorming, nominal group technique, interacting group and how it can be used to generate solution to conflict. Active & deep listening as a tool for problem solving.

Reading Material will be provided by the facilitator to the students. Students can refer the following links for better understanding of the concepts.

WEBLINKS:

1. http://apppm.man.dtu.dk/index.php/Group_Dynamics_and_Personality_Typ
2. https://www.managementstudyguide.com/types-of-personality.htm
3. https://www.hrpersonality.com/resources/conflict-management-techniques
4. https://thesystemsthinker.com/productive-conversations-using-advocacy-and-inquiry-effectively/

Articulation and Elocution

Course Code: CCT202
Credit: Audit Course
Total Number of Contact Hours: 6 Hrs.
Course Outcomes:

On successful completion of this course, the students should be able to:

CCT202.1. Use richer vocabulary in their communication appropriate to the context.

CCT202.2. Use appropriate grammar, vocabulary and style which are essential to professional-level reading, writing, speaking, listening, and editing.

CCT202.3. Apply various strategies to make the speeches/ conversation interesting and captivating.

CCT202.4. Using the sentence structure effectively and connect ideas logically within a paragraph.

CCT202.5. Write descriptions on various objects and topics.

Course Outline (Tentative Session Plan):

Sessions	Content	Activities
1	Listening	• To inculcate the skills of content prediction, inference and discourse coherence. • Acquire proficiency in Prosodic Features (Pronunciation, enunciation, pitch, intonation/voice modulation)
2	Ideation and Expression	• Proving situation/context to trigger thinking process • Just Minutes • Role Play/ Situational Dialogues • (Oral Narration) Describing people, places, events and things
3	Reading	• Distinguishing the main idea and supporting ideas • Transcoding information to diagrammatic display, recognizing indicators in discourse, understanding conceptual meaning and summarizing. • Reading and writing skills will be targeted simultaneously.
4.	Writing	• To throw some light on the features of the connected speech/ composition such as use transitional words, connectives, etc. • To explain various strategies for the organization of ideas such as introduction, development, transition, conclusion, emphasis, explanation and anticipation.
5	Vocabulary Building	• Introducing Idioms, Proverbs, Phrasal verbs and asking them to use the same. • Connotative and denotative meaning of the words. • To familiarize the students with the ways in which words are actually used in a particular context, especially with regard to their meanings, roots, prefixes suffixes, antonym & synonym.
6	Collecting and Analyzing Information	• Assigning students to read books, newspapers, magazines and stories to learn from, assess and improve analytical ability. • Allotment will be done before the class.

Reading Materials:

- Sanjay Kumar & Pushpa Lata "Communication Skills". New Delhi: Oxford University Press, 2011.
- M Ashraf Rizvi "Effective Technical Communication". Chennai, McGraw Hill Education, 2018

Note: Latest edition of the readings will be used.

Evaluation Scheme:

Evaluation Component	Weightage (%)
Attendance	10
Assignment(s)	30
Class Participation	10
Quiz	10
Project-I	15
Lab Evaluation-I	25
Total	100

Course code	Course Title	Teaching Scheme			
		L	**T**	**P**	**Credits**
PS1101	**Practice School – I**				**4**

Evaluation Scheme

S. No.	Evaluation Component		Marks (100) (Weightage %)
1	**External Supervisor**	**Day to Day task Record**	**30**
		Report Content and Presentation	**20**
2	**Faculty Supervisor**	**Reporting Activity Fortnightly**	**20**
		Presentation, Viv, Report	**30**

Syllabus:
This course is for 6 weeks at the end of 4th semester during summer term of 4 year full time B. Tech. and 5 year Integrated Dual degree (B.Tech + M.Tech, B.Tech + MBA) programs in all the engineering disciplines. The objective of this programme is to provide the students an understanding of working of corporate world in various functions associated with an Industry/Organization. During this programme, they will observe and learn various real-world applications of their curricula and develop an understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, data analysis etc. The general nature of PS-1 assignments is of study and orientation.

Course Title and Code: Design of RCC and Steel Structures CE1107	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-V**
Course Objective: This course aims to develop understanding about design of RCC and steel structure components for structural design.	
Course outcomes: **On successful completion of this course, students will be able to:** CE1107.1 Understand material properties and design methodologies for Concrete and Steel structures CE1107.2 Analyse and design reinforced concrete elements like beam and slab CE1107.3 Analyse and design steel elements like tension member and compression member CE1107.4 Design different type of connections for steel members	
Prerequisites	Structural Analysis

Course Syllabi (Theory):

Reinforced Concrete Materials: Concrete- Grade of concrete, Characteristic strength, Compressive strength, Flexural tensile strength, modulus of elasticity and Poisson's Ratio, creep & shrinkage, Stress-strain behavior, Design stress-strain curve of concrete, Nominal mix and design mix of concrete. **Reinforcing steel-** Types, sizes and grades, Stress-strain behavior, Design stress-strain curve. Sustainable concrete by using Recycled Concrete Aggregates (RCA) & other waste materials.
Basic concepts of Reinforced Concrete Design: Working Stress Method (WSM), Ultimate Load Method (ULM) and Limit State Method (LSM), Characteristic strength of materials, Characteristic loads, Partial safety factors for materials and loads.
Reinforced Concrete Beams: Design of singly & doubly reinforced rectangular sections in flexure, Design for shear, Design for bond and anchorage of reinforcement.
Slabs: Analysis and design of one way and two way slabs by LSM.
Introduction and Design Philosophies: Types of Structural Steel, structural steel sections, Working Stress Method (WSM) and Limit State Method (LSM).
Introduction to Connections: Types of Bolts, Bolted and Welded Connections under axial loadings.
Tension Members: Design of axially loaded tension members.
Compression Members: Design of axially loaded compression members, Design of Built-up Columns.

Syllabus (Practical)

Design problems based on theory syllabus

References:

Textbooks

1. Pillai, S.U. and Menon, D., "Reinforced Concrete Design", McGraw Hill Education (India) Pvt. Ltd (2003).
2. Sinha, S. N., "Reinforced Concrete Design", Tata McGraw Hill Education Pvt. Ltd. (Second Edition).
3. Jain, A.K., "Reinforced Concrete Limit State Design", Nem Chand & Brothers, Roorkee (2012)
4. Subramanian, N., "Steel Structures-Design and Practice", Oxford University Press (2008).
5. Arya, A.S. and Ajmani, J.L., "Design of Steel Structures", Nem Chand & Brothers (2000).
6. Duggal SK, "Limit State Design of Steel Structures", Tata McGraw Hill (Third edition)

IS Codes:
1. IS 456-2000 Plain and Reinforced Concrete - Code of Practice
2. IS: 800-2007 General Construction in Steel-Code of Practice
3. SP 6-1: ISI Handbook for Structural Engineers -Part- 1 Structural Steel Sections

NPTEL – SWAYAM MOOC Courses:

1) Design of Reinforced Concrete Structures.
   Course url: https://swayam.gov.in/nd1_noc19_ce22/preview
2) Design of Steel Structures
   Course url: https://swayam.gov.in/nd1_noc19_ce25/preview

Course Title and Course Code	**Geotechnical Engineering (CE1108)**
Hours per week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B.Tech, Semester-V**

Course Objective:

To introduce students to the fundamental concepts of soil mechanics dealing with historical development, water-capillary phenomena, vertical stress distribution, compaction behaviour, shear strength, compressibility and consolidation behaviours of soil.

Course Outcomes:

On successful completion of this course, the students should be able to:

- CE1108.1. assess index properties of different soil types.
- CE1108.2. evaluate the effect of pore water and seepage on the soil strength.
- CE1108.3. estimate vertical stress distribution beneath the foundation on account of superstructure load, up to certain depth.
- CE1108.4. calculate the shear strength of soil under different configurations of principal and shear stresses.
- CE1108.5. determine the compaction characteristics, optimum water content and maximum dry density of soil.
- CE1108.6. determine the consolidation characteristics of different type of soils and estimate the settlement under superstructure loads.

Prerequisites		**Engineering Mechanics and Solid Mechanics**
Sr. No	**Specifications**	**Marks**
1.	Attendance	Nil
2.	Assignment	Nil
3.	**Class Participation**	**5**
4.	**Quiz**	**15**
5.	**Theory Exam-I**	**20**
6.	Theory Exam-II	Nil
7.	**Theory Exam-III**	**30**
8.	Report-I	Nil
9.	Report-II	Nil
10.	Report-III	Nil
11.	**Project-I**	**10**
12.	Project-II	Nil
13.	Project-III	Nil
14.	**Lab Evaluation-I [Report (2.5) + Exam (10) + Viva (7.5)]**	**20**
15.	Lab Evaluation-II	Nil
16.	Course Portfolio	Nil
Total		**100**

COURSE SYLLABUS (Theory):

UNIT I Historical Development of Soil Engineering
Origin and general types of soils, Soil structure, Clay minerals, Three-phase system, Identification and Classification of soils.

UNIT II Soil Water-Capillary Phenomena
Concept of effective and neutral stresses, Permeability, Determination of coefficient of permeability in the laboratory, Seepage flow, Head, Gradient, Pressure, Steady-state flow, Two-dimensional flow net.

UNIT III Vertical Stress Distribution in Soil
Boussinesq and Westergaard's equation, Newmark's influence chart, Principle, Construction and Use, Equivalent point load and Other approximate methods, Pressure bulb.

UNIT IV Compaction and Shear Strength
Mohr-Coulomb failure criterion, Shear strength tests, Different drainage conditions, Shear properties of cohesionless and cohesive soils, Use of Mohr's circle, Relationship between principal stresses and shear parameters.

UNIT V Compressibility and Consolidation
Terzaghi's one-dimensional consolidation theory, Pressure void ratio relationship, Preconsolidation pressure, Total settlement and time rate of settlement, Coefficient of consolidation, Curve fitting methods, Correction with construction time.
UNIT VI Sustainability in Geotechnical Engineering

Indian Standard Codes for Geotechnical Engineering (IS 2720, Part 1-41, IS 6403, etc.).
COURSE SYLLABUS (Practical):

1. Collection of Soil Sample and Determination of Moisture Content
2. Determination of Specific Gravity by (a) *Density bottle* and (b) *Pycnometer*
3. Grain Size Distribution of Soil Using Dry Sieve Analysis
4. Grain Size Distribution of Soil Using Wet Sieve Analysis
5. Particle Size Distribution Using Hydrometer
6. Determination of Liquid Limit Test by Casagrande Apparatus
7. Determination of Liquid Limit Test by Cone Penetrometer
8. Plastic Limit Test
9. Shrinkage Limit Test
10. Field Density Test by Core Cutter Method
11. Field Density Test by Sand Replacement Method
12. Standard Proctor Compaction Test
13. Modified Proctor Compaction Test
14. Consolidation Test

Text Books:

1. Arora, K. R. (1992). *Soil Mechanics and Foundation Engineering in SI Units*. Standard Publishers Distributors.

2. Coduto, D. P. (1999). *Geotechnical Engineering: Principles and Practices,* Pearson.
3. Lambe, T. W., & Whitman, R. V. (2008). *Soil mechanics SI version*. John Wiley & Sons.
4. Murthy, V. N. S. (2002). *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*. CRC press.
5. Punmia, B., & Jain, A. K. (2005). *Soil Mechanics and Foundations*. Firewall Media.
6. Ranjan, G., & Rao, A. S. R. (2007). *Basic and Applied Soil Mechanics*. New Age International.
7. Singh, A., & Chowdhary, G. R. (1967). *Soil Engineering in Theory and Practice*. Asia Publishing House.
8. Venkatramaiah, C. (1995). *Geotechnical Engineering*. New Age International.

Other Important Links:

1. Online Lecture Notes on Geotechnical Engineering: (*https://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/soil_mech/index.htm*)
2. Video Lecture on Geotechnical Engineering:

(*https://www.youtube.com/watch?v=DuZllNDex6s*)

Course Title and Code: Mechanical and Electrical Machines: ES1108	
Hours per Week	**L-T-P-S: 3 0 2 0**
Credits	**4**

Syllabus (Theory)

UNIT – I

Transformer: 1-Phase transformer: Working principle, Construction, EMF equation, Equivalent circuit and phasor diagram, losses and Efficiency, O.C. /S.C. Test, Polarity Test, 3-Phase transformer: Construction, Connections and phasor groups. ***Standards: IEC60616***

D. C. Machines: D.C. Generator: Construction, Armature Winding, EMF Equation, Armature reaction, characteristics of dc generators, applications.

D. C. Motor: Construction, Operation of a DC Motor, performance characteristics of DC Motors, Losses in a DC Motors, Methods of Speed Control, applications.

UNIT – II

Boilers: Purpose, Classification of boilers, Fire tube and water tube boilers, Mountings and accessories, construction and working of Cornish, Cochran, Lancashire, Locomotive, Babcock and Wilcox boilers, boiler performance. Construction and working of Loeffler, Velox, Benson, Lamont boiler. Efficiency of boiler.

Turbines: Introduction to steam turbines, Working of Impulse and Reaction turbines, compounding of steam turbines, losses in steam turbines, need of governing, throttle governing, nozzle governing and bypass governing.

UNIT – III

Synchronous Machines:

Synchronous Generator: Basic concepts, types and construction, generated emf, distribution &Pitch factor, armature reaction, phasor diagram.

Synchronous Motor: Working principle and construction, phasor diagrams, speed torque characteristics, starting methods, applications.

UNIT - IV

Induction Motor: Theory and construction of squirrel-cage and wound-rotor motors; equivalent circuit; measurement of equivalent circuit parameters, speed and slip, starting & running torque, speed/torque curves. ***standards: EEMUA132.***

Pumps: Types of pumps, positive displacement pumps, rotary type positive displacement pumps like gear pump, screw pump, rotary vane pumps; reciprocating type positive displacement pumps like piston pumps, plunger pumps. Centrifugal pumps working principle, pressure head, velocity head.

UNIT –V

Stepping Motors: Construction, working and application.

List of Experiments:

1. Open circuit characteristics of D.C. generator
2. Measurement of torque and speed of D.C motor operating in the workshop for lathe operation.
3. Speed control of D.C. shunt motor by (a) Field current control method & plot the curve for speed vs. field current. (b) Armature voltage control method & plot the curve for speed vs armature voltage.
4. To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.
5. To perform no load and blocked rotor test on a 3-phase induction motor and to determine the parameters of its equivalent circuits. Draw the circle diagram and compute the following (a) Max. Torque (b) Current (c) slip (d) p.f. (f) Efficiency.
6. To plot OCC & SCC of an Alternator and to determine its regulation by synchronous impedance method.

7. To find efficiency of a given boiler.
8. To find power output & efficiency of a steam turbine.
9. To find efficiency of a reciprocating pump.
10. To find efficiency of a Gear pump.

Textbooks:

1. Nagrath I. J. and Kothari D.P, "Basic Electrical Engineering" TMH, Third Edition 2011.
2. B. L. Theraja, "A Text Book on Electrical Technology" S. Chand, VolumeII. 2012.
3. Electric Machinery and Transformers-Bhag S. Guru, Huseyin R. Hiziroglu-Oxford Publication.
4. J B Gupta, "Theory and Performance of Electrical Machines"4th Edition, S. K. Kataria and Sons
5. Power plant Engineering, P.K. Nag, Tata McGraw-Hill, 2008.
6. Steam and Gas turbines and power plant engineering- Dr. R Yadav, Central Publishing House, Allahabad, 2011.
7. Introduction to Fluid Mechanics and fluid machines- Author: S K som, Gautam Biswas, Mc Graw Hill.

Reference Book(s)

1. Electrical Engineering - Principles and Applications, Allan R. Hambley, PHI, fourth edition- 2007.
2. Electrical Machines by P S Bhimbra- Khanna Publishers.
3. Ashfaq Hussain, "Electrical Machines" 2nd Edition, Dhanpatrai and Sons.
4. A. E. Fitzerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery" 6th Edition, Tata McGraw-Hill.

Course Title and Code: Communication and Identity |CC1104|		
Course Objective: This course enables students to explore their personal and professional identities, to create their distinctive presence. It intends to help them gain an understanding of the basic purpose, benefits, and responsibilities of self-presence, and to begin the process of defining their values, strengths, and goals, which also helps them enhancing their professional readiness. **Course Outcomes** CC1104.1 Analyse their personal identities, both private and social CC1104.2 Identify their different values, strengths and areas of professional interest CC1104.3 Articulate their personal statement and use it to craft an influential pitch CC1104.4 Express themselves through various communication formats on different platforms		
Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-1**
Credits		**2**
Sr. No	**Specifications**	**Weightage**
1.	Assignment	40
2.	Class Participation	10
3.	Theory Exam III	30
4.	Presentation	20
	Total	**100**

Syllabus:

Module	**Topics**	
Identifying Self	Factor that shape our identity	The 3 Types of Diversity that shape our identities. Three things: demographic diversity (our gender, race, sexual orientation, and so on), experiential diversity (our affinities, hobbies, and abilities), and cognitive diversity (how we approach problems and think about things).
	Internal confidence or "principle-centred living"	Living a principle-centred life is the key to excelling in all other areas of our living. A principle is based on the fundamental idea that there is learned behavior that governs human effectiveness.
	Personal Statement	Use of story map to create a personal statement.
Persuasive Communication	Steps to build a Personal Identity	Personal Identity through brand building exercise: meaning, importance and how to create and use it; the three Cs of personal branding
	Online presence	Creating an online presence for professional and personal branding through social media. (LinkedIn, Facebook etc.)
	Elevator Pitch, Cover Letter	Elevator Pitch: Meaning and use of an elevator pitch in interview and workplace; techniques to craft and improve their pitch

		Purpose of a cover letter, types of the cover letter, the structure of a cover letter and tips on the cover letter, to craft their cover letter to be used for placements
	Presence in Group Discussion and Personal Interviews	Practice different types of group discussions, dos and don’ts of group discussions and use of techniques to perform well in GDs

References for Reading:

1. O’Brien, T. (2019). When your job is your identity, professional failure hurts more. *Harvard Business Review*.
2. Anca, C., & Aragón, S. (2018). The 3 types of diversity that shape our identities. *Harvard Business Review*.
3. Craig, N., & Snook, S. (2014). From purpose to impact. *Harvard business review*, *92*(5), 104-111.
4. Detert, J. R. (2018). Cultivating everyday courage. *Harvard Business Review*, *96*(6), 128-135.
5. Dutta, S. (2010). What's your personal social media strategy? *Harvard business review*, *88*(11), 127-30.

MANAGEMENT PERSPECTIVES (IL1101)

COURSE CREDITS: 2
SESSION DURATION: 60 MINUTES

COURSE DESCRIPTION:

The present course is an introductory and integrative action encapsulated course designed for the engineering students to introduce them to management discipline and the core functional areas contributing to it. This course adopts the integrated problem-oriented approach via the use of cases and simulation. It implies that complex business problems, in the form of cases and simulations require students to understand different dimensions of the problem and come up with holistic solutions. The course will help students to be familiar with trending management issues and at the same time apply the knowledge gained.

COURSE OUTCOMES

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

- IL1101.1. Comprehend the importance of management and its functional areas in businesses and also its interaction with technology.
- IL1101.2. Highlight specific external and internal issues impacting businesses.
- IL1101.3. Integrate and analyze multiple dimensions of management aspects to solve business problems.
- IL1101.4. Evaluate the aspects that management might consider when evaluating technical and engineering projects such as planning and scheduling, personnel management, cost control etc. from a management perspective

TOPICS TO BE COVERED:

HR

1. Business organization- Current challenges
2. HR and its growing importance.
3. Overview of people management systems
4. Recent trends shaping HR.

Economics:

1. Introduction of important concepts of Micro and Macro Economics
2. Key Features of Indian Economy
3. Understanding of economic environment of business

Marketing:

1. Marketing Process
2. Elements of Marketing Mix
3. Segmentation, Targeting and Positioning

Finance and Accounts:

1. Understanding Accounting Terms

2. Overview of Financial Reports, viz., Balance Sheet, Income Statement, Cash Flow Statement
3. Interface of Balance Sheet and Income Statements
4. Types of Costs and assessing and ascertaining Costs

BOOKS FOR REFERENCE

- Aswathappa, K. (2008) - Human Resource Management Text and Cases, Tata McGraw Hill New Delhi.
- Rao VSP (2002)– Human Resource Management, Text and Cases, Excel Book, New Delhi
- Armstrong, G. and Kotler, P. (2017). Marketing: An Introduction. New Delhi: Pearson Education.
- Ramaswamy, V. S., & Namakumari, S. (2013). Marketing Management: Global Perspective, Indian Context. New Delhi: Macmillan (India) Limited.
- T. R. Jain (Latest Edition). Economics for Engineers. New Delhi: V K Publications.
- Ramachandran N & Kakani K.Ram.(2017). How to Read a Balance Sheet,2/e. New Delhi: Mc Graw Hill Publications.
- Mott Graham. (2008). Accounting for Non-Accountants: A Manual for Managers and Students. Kogan Publication.
- Goyal, V.K. & Goyal, Ruchi. (2016). Financial Accounting, 4/e, New Delhi: PHI Learning Pvt. Ltd. [ISBN. -978-81-203-4626-0]

ASSESSMENT MATRIX

The criteria for assess the learning outcomes of this course are as follows:

S. No.	**Specification**	**Marks**
1	Attendance	**10**
2	Assignment	Nil
3	Class Participation	**10**
4	Quiz	Nil
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	**40**
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	**40**
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil

15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total	**100**

Course Title and Code: Transportation Engineering CE1109	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B.Tech Semester-VI**

Course Objective:
This course aims to develop understanding about concepts of highway planning, design and construction to ensure safe and effective transportation of people and goods through roads.

On successful completion of this course, students will be able to:

- CE1109.1. Plan and design the alignment of highway.
- CE1109.2. Characterize highway construction materials and application of sustainable highway materials.
- CE1109.3. Plan and conduct various types of traffic studies.
- CE1109.4. Design geometric features of highway as per IRC:86.
- CE1109.5. Design of flexible and rigid pavements as per IRC:37 & IRC:58 respectively.

Prerequisites		NA
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment	**10 (02 Assignment)**
3	**Class Participation**	**10**
4	**Quiz (02 Nos.)**	**10**
5	**Theory Exam-I**	**10**
6	Theory Exam-II	-
7	**Theory Exam-III**	**20**
8	Report-I	**10 (Report)**
9	Report-II	10 (Presentation)
10	Report-III	
11	**Project-I**	**NIL**
12	Project-II	-
13	Project-III	-
14	**Lab Evaluation-I (Continuous Evaluation)**	**10 (Physical Lab and Virtual Lab)**
15	**Lab Evaluation-II (Examination)**	**10**
16	Course Portfolio	NIL
	Total (100)	**100**
	Theory Exam	**30**

Course Syllabus (Theory):

Highway Development & Planning: Importance of transportation in economic activity and social effects, characteristics of road transport. Current road development plans in India, Classification of roads, road patterns. Highway alignment and preparation of highway Detailed Project Report (DPR).

Highway Materials: Desirable properties, laboratory test and MORTH specifications on materials: sub-grade soil; aggregate and bitumen Grading systems for bitumen: penetration grading, viscosity grading and super-pave performance grading. Modified bitumen: PMB & CRMB, cutback bitumen and bitumen emulsions. Green highways: Importance and application of sustainable materials in highway construction RAP (Recycled Asphalt Pavement) and RCA (Recycled Concrete Aggregates).

Highway Geometric Design: Cross sectional elements, camber, sight distance (SSD, OSD and ISD). Design of horizontal alignment: super elevation, extra widening, transition curves, grade compensation. Design of vertical alignment: gradients, vertical curves. Recommendations for highway geometric design parameters as per IRC code of practice (IRC: 73, IRC: 86).

Traffic Studies: Objects, methods and data presentation of various traffic studies such as classified traffic volume studies; spot speed studies; travel time and delay studies; origin & destination studies. Parking studies: Investigations and determination of parking demand; Accident studies: Objectives & causes of accidents; 3Es measures used for the reduction of accident rate.

Highway Flexible Pavement: Factors affecting design & performance of flexible pavements, component layers, structural design of highway flexible pavement as per IRC:37guidelines.

Highway Rigid Pavements: Component layers, factors affecting design & performance of rigid pavements. Types of joints in rigid pavements: longitudinal, contraction, expansion & construction joints. Temperature stresses: warping and frictional stresses, Wheel load stresses, Design of rigid pavements as per IRC:58 guidelines.

Text and reference books:

1. Highway Engineering by S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Bros., Roorkee.
2. Bituminous Road Construction in India by Prithvi Singh Kandal, PHI Learning Private Limited, Delhi.
3. Traffic Engineering & Transport Planning by L R Kadiyali, Khanna Publishers, New Delhi.
4. Principles of Transportation Engineering by Partha Chakroborty & Animesh Das, PHI, New Delhi.
5. Highway and Traffic Engineering by Subhash C. Saxena, CBS Publishers and Distributors Pvt. Ltd.
6. Specifications for Road and Bridge Works, Fifth Revision, Ministry of Road Transport and Highways (MORTH), Indian Roads Congress, New Delhi.
7. Indian Road Congress standards (IRC: 73, IRC: 86, IRC: 37, IRC:58).

Syllabus (Practical)

1. CBR test for subgrade soil (Virtual Lab)
2. To determine the flakiness index & elongation Index of given sample of aggregate (Physical Test)

3. Aggregate Impact test (Physical & Virtual Lab)
4. Los angles abrasion test (Virtual Lab)
5. Aggregate crushing value test (Virtual Lab)
6. Ductility of bitumen (Physical & Virtual Lab)
7. Softening point of bitumen (Physical & Virtual Lab)
8. Flash and fire point of bitumen (Physical Test)

Ref: Virtual Lab by NIT Karnataka
http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Transportation_Engineering_Lab/labs/index.html

Course Title and Code **Construction Project Management:** CE 1112	
Hours per Week	**L-T-P: 3-0-2**
20Credits	**4**
Students who can take	B. Tech Sem VI sem (2017-2021) (CE)
Course Objective: This course aims to develop understanding for importance of estimation, costing and evaluation, construction project management, project planning, cash flow and time management and safety measures at the project site. Topics include estimation, costing, evaluation, management, role of civil engineer, project scheduling with PERT, methods to reduce the project cost, contract management and safety measures at excavation, demolition, roads and other construction sites.	

Course Outcomes

On completion of the course, the student should be able to:

CE1112.1. Calculate the estimated cost of the project

CE1112.2. Compute the Benefit cost ratio of various type of projects.

CE1112.3. Asses the risks in various Civil Engineering projects.

CE1112.4. Analyze the project schedule by CPM and PERT.

CE1112.5. Evaluate various types of contracts.

CE1112.6. Develop various methods of safety in various construction projects.

CE1112.7. Incorporate sustainability in project planning and execution.

CE1112.8. Develop project scheduling using MS project.

Prerequisites		
Teaching Scheme (Hours per Week)		3 0 2
Credits		4
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	Nil
2	Assignment	10 (5 Nos)
3	Class Participation	10
4	Quiz (3)	0
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	25
8	Report-I	5
9	Report-II	0
10	Report-III	0
11	Project-I	10
12	Project-II	0
13	Project-III	20
14	Lab Evaluation-I	5 (Physical Lab and Online Sessions)
15	Lab Evaluation-II	5
16	Course Portfolio	
	Total (100)	**100**
Evaluation scheme for retest		

1	Theory Exam III	25
2	Lab Evaluation II	5

Syllabus (Theory)

CONSTRUCTION AND PROJECT MANAGEMENT: Construction Project, Importance of Construction and Construction Industry, Indian Construction Industry, Project Management and Its relevance, Stake holder of a construction Project, Role of Civil Engineer in Project Management, Stages in Construction, Project Organization: Construction Company, Structure of construction Organization, Management levels, Construction Economics: Benefit cost ratio, Average Annual rate of return, Major cause of project failure, Role of arbitrator in project management

PROJECT PLANNING: Importance of project planning, Types of Project Plans, determining activities involved, work breakdown structure, assessing activity duration, duration Estimate procedure, Project work scheduling, Project management techniques – CPM and PERT networks analysis, concept of precedence network analysis.

PROJECT COST AND TIME CONTROL: Monitoring the time progress and cost controlling measures in a construction project, Time cost trade-off process: direct and indirect project costs, Cost slope, Process of crashing of activities, determination of the optimum duration of a project, Updating of project networks, resources allocation.

CONTRACT MANAGEMENT: Elements of tender operation, Types of tenders and contracts, Contract document, Legal aspects of contracts, Contract negotiation & award of work, breach of contract, determination of a contract, arbitration.

SAFETY AND OTHER ASPECTS OF CONSTRUCTION MANAGEMENT: Causes and prevention of accidents at construction sites, Safety measures to be followed in various construction works like excavation, demolition of structures, explosive handling, hot bitumen work. Project Management Information System – Concept, framework, benefits of computerized information system. Environmental and social aspects of various types of construction projects.

Syllabus (Practical)

Various modes of measurements, measurement sheet and abstract sheet;

Types of estimate, plinth area rate, cubical content rate, preliminary, original, revised and supplementary estimates

Basic schedule of rates. (C.S.R.)

Preparing detailed estimates of various types of buildings, R.C.C. works, earth work calculations for roads and estimating of culverts, Services for building such as water supply, drainage and electrification.

Various percentages of overhead charges, Contingencies and work charge establishment different services in building.

Text /Reference Books:

1. Dutta B. N. Estimating & Costing in Civil Engineering, UBS Publishers, 2016
2. Jha N K. Construction project Management Pearson, 2015.
3. Chitkara K K. Construction Project Management, Mc Graw Hill 2014.
4. Punmia B C and Khandelwal K K. Project Planning and Control with PERT and CPM. Laxmi Publication 2014.

Course Title and Code: Critical Thinking for Decisions at Workplace |CC1106		
Course Description: In today's world, the idea of right and wrong is being challenged by businesses, use of technology, economic conditions, and norms of societies. The relevance of a well-reasoned decision is crucial. This course intends to make students take better decisions keeping in mind purpose, context, and ethics. **Course Outcomes** *The students will be able to:* CC1106.1 Apply techniques of critical thinking to analyse organisational problems through positive inquiry CC1106.2 Describe and analyse appropriate problem-solving and ethical decision-making processes CC1106.3 Choose the most effective and logical decision among multiple alternatives CC1106.4 Evaluate solutions and anticipate likely risks based on purpose, context and ethics		
Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-0**
Credits		**2**
Sr. No	**Specifications**	**Weightage**
1	Attendance	10
2	Assignment	30
3	Class Participation	10
4	Quiz	-
5	Theory Exam-II	15 (Individual viva)
6	Theory Exam-III	15 (online mode)
	Presentation	20
	Total (100)	**100**

References for Readings:

1. Lehrer, J. (2010). *How we decide*. Houghton Mifflin Harcourt.
2. Heath, C., & Heath, D. (2013). *Decisive: How to make better choices in life and work*. Random House.
3. Hammond, J. S., Keeney, R. L., & Raiffa, H. (2015). *Smart choices: A practical guide to making better decisions*. Harvard Business Review Press.
4. Cases and scenario will be shared in the class.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1111	**Introduction to IoT**	**1**	**0**	**2**	**0**	**2**

Course Objectives:

The course aims to develop understanding of Internet of Things concepts and working on IoT development boards to interface sensors and actuators. The course will enable the students to upload data from sensors on a web server and to use this data for analytical purposes or to actuate some transducers.

Course Outcomes:

On successful completion of this course, the students should be able to:

- EE1111.1. Interface the Analog and Digital sensors to Node-MCU
- EE1111.2. Develop Embedded C programs to read sensor data and upload to public cloud platform.
- EE1111.3. Use Python-based IDE (integrated development environments) for the Raspberry Pi
- EE1111.4. Interface Raspberry Pi with I/O devices.
- EE1111.5. Visualize sensor data uploaded on public cloud.
- EE1111.6. Apply standard protocol(s) for implementation of IoT Systems.
- EE1111.7. Analyze and Improve existing systems with innovative IoT based approaches.

Assessment Scheme:

Teaching Scheme (Hours per Week)		L T P 1 0 2
Credits		2
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	NA
3	Class Participation	NA
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	NA
7	Theory Exam-III	20
8	Report-I (Case Study on Raspberry Pi, IoT)	20
9	Report-II	NA
10	Report-III	NA
11	Project-I	NA
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I (Continuous)	30
15	Lab Evaluation-II	NA
16	Course Portfolio (MOOC certificate)	10
	Total (100)	100
Evaluation Scheme for Retest		
1	Theory Exam-III	20
2	Lab Evaluation-II	0

	Total (40)	20

Course Syllabi (Theory):

UNIT 1: Introduction to IoT Fundamentals: Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking.

UNIT 2**:** Sensors and Actuators: Sensors and Transducers, Sensor Classes, Sensor Types, Actuator Basics, Actuator Types,

UNIT 3**:** Basics of IoT Networking & Protocol: IoT Components, Inter-dependencies, SoA, Wireless Networks, Protocol Classification, MQTT, Secure MQTT, CoAP, XMPP, AMQP (Advanced Message Queuing Protocol)

UNIT 4**:** Connectivity Technologies: IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave.

UNIT 5**:** Introduction to NodeMCU and Server: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Interfacing different sensors with NodeMCU. Introductio to Blynk App, Uploading and downloading data from server using Blynk App. Intoduction to ThingSpeak Server, Uploading and downloading data from ThingSpeak server.

UNIT-6 Raspberry Pi: Basic functionality of the Raspberry Pi B+ board, Setup and Configuring Raspberry Pi, programming on the Raspberry Pi using Python, Python functions to access the Raspberry Pins, how Raspberry Pi interact with online services through the use of public APIs and SDKs, case studies.

References:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3. Rajkamal, Internet of Things, Architecture and Design Principles, Mc. Graw Hill Education (India) Pvt Ltd.
4. IoT fundamentals: networking technologies, protocols, and use cases for the internet of things: Hanes, David | Salgueiro, Gonzalo | Grossetete, Patrick | Barton, Robert Henry, Jerome, Pearson, 2018, ISBN: 9789386873743.
5. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT by David Etter.

Video lectures:

1. Introduction to internet of things By Prof. Sudip Misra, IIT Kharagpur

https://swayam.gov.in/nd1_noc20_cs66/preview

2. https://www.coursera.org/specializations/iot#courses
3. https://www.coursera.org/specializations/embedding-sensors-motors

MOOC course

The Arduino Platform and C Programming

https://www.coursera.org/learn/arduino-platform?specialization=iot#syllabus

Course Title and Code: Minor Project PR1103	
Prerequisites	**Nil**
Hours per Week	**L-T-P:**
Credits	**04**
Students who can take	**B.tech. Semester VII**

Course Objective:

In Minor Project, Students are expected to work towards the goals and milestones set in Minor Project. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. At the end there would be a demonstration of the solution and possible future work on the same problem. The student will have to present the progress of the work through seminars and progress reports. (in continue contact with Faculty Supervisor Assigned)

Operation Procedure

- Student has to devote full semester for Minor Project.
- Student has to report to the Supervisor regularly.
- Seminars s evaluation has to be carried out in the presence of atleast two-member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Assessment Scheme:

Sr. No	Specifications	Marks
01	Attendance	NIL
02	Assignment	NIL
03	Class Participation	NIL
04	Quiz	NIL
05	Theory Exam (Mid Term)	NIL
06	Theory Exam	NIL
07	Theory Exam(Final)	NIL
08	Report-1 (Synopsis) (Panel)	15
09	Report-2	NIL
10	Report-3	NIL
11	Project -1 (Mid Term) (Panel)	20
12	Project -2 (Day to Day work) (Demo, Presentation, Viva, Report)	25
13	Project -3 (End Term) (Panel) (Demo, Presentation, Viva, Report)	40
14	Lab Evaluation – I	NIL
15	Lab Evaluation – II	NIL
16	Course portfolio	NIL
	Total (100)	**100**

Course code	Course Title	Teaching Scheme	
		NA	Credits
PR1101	**Automation Project**		2

Course Objectives: The course aims to train students for designing and implementing solutions for Automation using Internet of Things.

Course Outcomes:

On successful completion of this course, the students should be able to:

PR1101.1. Design and implement a complete project in IoT using Node-MCU and sensors using Embedded C programs

Or

Design and implement a complete project in IoT using Raspberry pi and sensors using Python programs

PR1101.2. Apply one/more standard protocol(s) during project implementation

PR1101.3. Demonstrate sensitivity to sustainability issues for power consumption / Bandwidth utilization/economic solutions during implementation of projects**.**

Assessment Scheme:

r. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	Nil
8	Report I (Synopsis)	30
9	Report II (Midterm Progress Presentation and Viva)	30
10	Report III	Nil
11	Project I (with Report)	Nil
121	Project II	Nil
13	Project III (With working model)	40
14	Lab Evaluation I	Nil
15	Lab Evaluation II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
	Evaluation scheme for retest.	
	Project III (with Report)	**40**
	Total (100)	**40**

PS1102/PR1105/PR1104 –

Practice School-II/Entrepreneurial Project/ Research Project

Course Syllabi:
This course is for five four and half months (summer and one semester) in VII or VIII Semester. The objective of this programme is to provide the students, an opportunity to work on live projects of corporate world in various fields. During this programme, they will work on real world applications of their curricula through organizational function of their choice. The students are expected to be involved directly in problem solving efforts of specific interest to the host organization. The learning of PS-I will help them in completing PS-II successfully. PS-II duration of internship is 4 - 4.5 months. PS -II Winter internship Dec to May.

Course Code	Course Title	Teaching Scheme	
		Total Duration	Credits
PS1102/PR1105/ PR1104	Practice School-II/ Entrepreneurial Project/ Research Project	4 months	16

Evaluation Scheme:			
Expert Evaluation	Evaluation Component	Mid-Term	Final Term
Industry Expert	Day to Day Task Record	20	40
	Report Content & Presentation	10	30
JKLU faculty	Reporting Activity Fortnightly	8	18
	Presentation, Viva, Report	20	50
	PS-2 Coordinator Feedback	2	2
	Total	60	140

Course Title and Code: Public Health Engineering CE1201	
Hours per week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B.Tech Semester-V (Batch: 2017-2021)/ DE**

Course Objective:
This course aims to develop critical thinking and engineering problem solving skills by exploring and proposing sustainable solutions for current water and waste water problems.

On successful completion of this course students will be able to:

- CE1201.1 Identify current public health problems within a broader framework of sustainable development.
- CE1201.2 Use research tools and analytical methods to critically monitor and assess the water and wastewater management problems.
- CE1201.3 Develop treatment plant layout and analyse main physical, chemical and biological processes for water and wastewater treatment.
- CE1201.4 Design water treatment and wastewater treatment units to meet the drinking water and discharge/reuse standards.

Prerequisites		Basic science and mathematical Skills
Sr. No.	**Evaluation Component**	**Marks**
1.	Attendance	NIL
2.	Assignment	10
3.	Class Participation	10
4.	Quiz	10
5.	Theory Exam-I	NIL
6.	Theory Exam-II	10
7.	Theory Exam-III	20
8.	Report-I	NIL
9.	Report-II	NIL
10.	Report-III	NIL
11.	Project-I	20
12.	Project-II	NIL
13.	Project-III	NIL
14.	Lab Evaluation-I (Continuous Evaluation)	10
15.	Lab Evaluation-II (Lab Examination)	10
16.	Course Portfolio	NIL
	Total	100

<u>Course Syllabi (Theory)</u>:

UNIT-1: General requirement for sustainable water supply, Quality and quantity of water, Domestic water quality standards; Water analysis (CPCB, ISO, WHO standards).
UNIT-2: Physical, chemical and biological characteristics of water and their significance, water quality criteria, Process of treatment: mixing, aeration, sedimentation, coagulation, disinfection, softening.
UNIT-3: Distribution systems pump, pumping systems, distribution systems- analysis and

distribution of network, layout of distribution system, methods of water supply, distribution reservoir, and capacity of reservoirs.

UNIT-4: Waste water treatment: sewage and effluent, sources of wastewater, classification of wastewater, characteristics and testing of sewage, composition, sampling, physical and chemical analysis. Waste water discharge standards.

UNIT-5: Waste treatment process: objectives, significance of treatment, and classification of treatment processes, Activated sludge process, wastewater treatment operations, screenings, skimming, sedimentation, biological treatment, aerobic and anaerobic treatment, Design of STP

Syllabus (Practical):

1. Determination of PH of given in water /waste water sample
2. Determination of Alkalinity in water sample
3. To determine the Total Dissolved Solids of the given water/sewage sample
4. Determination of Hardness in water sample
5. Determination of CO_2 in water sample
6. Determination of turbidity of water supply system
7. Determination of chlorine demand and chloride residuals in water supply system
8. To determine Total Suspended Solids (TSS) of the given sewage sample.
9. To find out the Quantity of Dissolved Oxygen present in the given waste water /water sample
10. Determination of Biochemical Oxygen Demand exerted by given wastewater sample
11. To find out Chemical Oxygen Demand of the waste water

References:

Textbooks

1. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
2. Environmental engineering: Wastewater engineering, SK Garg, Khanna Publishers
3. Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd.
4. Water Supply Engineering, Dr. B.C. Punmia Laxmi Publications Pvt. Ltd.
5. Water and wastewater engineering, Metcalf and Eddy, McGraw Hill
6. Standard Handbook of Environmental Engineering, by Robert A. Corbitt, McGraw-Hill Professional publication.
7. Industrial waste treatment by Nelson Leonard Nemarow

E-books

1) Textbook Of Environmental Engineering by by P. Venugopala Rao
2) Environmental Engineering by D. Srinivasan.

Video Lectures

1) NPTEL >> Civil Engineering >> Water and Waste Water Engineering (Video) >>
2) https://www.youtube.com

Websites (related to the course)

1) http://www.cpcb.nic.in/
2) http://www.rpcb.rajasthan.gov.in

3) http://www.bis.org.in/
4) http://www.who.int/en/
5) 3. http://www.moef.gov.in/
6) http://www.greentribunal.gov.in/

BASIC COURSE IN ENTREPRENEURSHIP IM311
SEMESTER V (All Branches B.Tech.)

L-T-P: 3-0-0
COURSE CREDITS: 3
SESSION DURATION: 60 MINUTES

1. COURSE DESCRIPTION

This is an open course for all the IInd Year management students (BBA & B.Com) and IIIrd Year Engineering Students. It is one of the fastest growing subjects in colleges and Universities across the world. It has been identified as one of the major trends shaping business, economy and even society. This course is about creating, managing and leading an entrepreneurial organisation. It would enable students to start dreaming big, visualizing and working towards the realization of their dreams. The programme imparts essential knowledge of how to start one's own business venture and the various facets that influence successful set up and operations. The teaching/ learning of entrepreneurship require greater focus on experiential learning. Engagements such as interactive sessions, cases, games, exercise, role plays, films, projects, assignments, simulation and group activities play a vital role in teaching this course. This course is supported by Wadhwani Foundation and facilitated through Learnwise.

2. COURSE OBJECTIVES

To encourage students to nurture their entrepreneurial traits and think creatively to develop innovative ideas/products for commercial exploitation.

3. COURSE OUTCOMES

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

IM311.1. Identify problem worth solving through design thinking.
IM311.2. Identify customer segment and niche for specific markets.
IM311.3. Craft Value Preposition Canvas.
IM311.4. Create business model using Lean Canvas Template
IM311.5. Build ‘A’ team for new start-ups.
IM311.6. Design and validate solution demo and MVP.
IM311.7. Analyse cost, revenue, key channels and pricing model for the venture.

4. TOPICS

- Overview of Entrepreneur and Entrepreneurship
- Self-Discovery
- Opportunity Discovery
- Identify Customer and Craft Value Preposition
- Business Model
- Validation
- Money (Revenue, Costs, Pricing and Financing)
- Team Building
- Marketing and Sales
- Support (Business Regulation)
- Project

5. EVALUATION COMPONENT

Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	20
03	Class Participation	Nil
04	Quiz	10
05	Theory Exam	Nil
06	MID TERM -2, Theory Exam	Nil
07	END TERM Theory Exam	30
08	Report-1	20
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	Nil
	Total	**100**

Course Title and Code: Municipal and Urban Engineering CE1202	
Hours per Week	L-T-P: 3-0-2
Credits	4
Students who can take	B. Tech all branches (Open Elective)
Prerequisites	Basic science

Course Objective:
To develop understanding about the engineering related urban planning and management especially focusing on transportation, water and waste management.

Course Outcome:
On successful completion of this course students will be able to:

CE1202.1	Apply the various standards for urban traffic planning.
CE1202.2	Manage the working of various transport systems in different scenarios.
CE1202.3	Plan a solid waste management system for a given urban area.
CE1202.4	Select appropriate SWM options in a specific local context.
CE1202.5	Characterize water and wastewater effluents.
CE1202.6	Design water supply and waste water treatment system.
CE1202.7	Make a plan to process water, wastewater treatment and sludge handling.

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment (03)	15
3	Class Participation	10
4	Quiz (02)	10
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	25
8	Report-I	15
9	Report-II	15
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I(Continuous Evaluation)	NIL
15	Lab Evaluation-II (Lab Examination)	10
16	Course Portfolio	NIL
	Total	**100**

Evaluation Scheme for Retest

Sr. No	Specifications	Marks
1	Theory Exam-III	25

Course Syllabi (Theory):

Urban Traffic Planning & Management: Modes of transportation, Characteristics of various modes, Socioeconomic effect of transportation, objectives of transport planning, urban traffic & transport problems, steps in urban transport planning process, traffic system management measures, pedestrian & cyclist management measures, Intelligent Transportation System (ITS) and its advantages, Use of ITS in India, alternative urban transportation systems such as BRT, Metro & mono rail.

Water Supply Engineering: General requirement for water supply , Quality and quantity of water, Domestic water quality standards; Water analysis (ISO, WHO standards), Sources of water and their yield, Water supply forecast, population forecast, variation in demand pattern, design period; pumping and transportation of water. Water treatment and distribution systems. Methods of water supply.

Waste Water Treatment: Waste water treatment, sewage and effluent, sources of wastewater, classification of wastewater, characteristics and testing of sewage, composition of waste water, sampling, significance of treatment, classification of treatment processes, wastewater treatment operations, screenings, skimming, sedimentation, biological treatment, CNG production at Sewage treatment Plants, Sludge treatment, Use of manure for sustainable agriculture.

Solid Waste Management: Generation and characterization of solid waste, challenges in waste collection, methods of solid waste disposal, energy recovery from solid wastes, 3 R (reduce, reuse, recycle) principal for sustainable development.

Syllabus (Practical)

1) Determination of PH of given in water /waste water sample
2) Determination of Alkalinity in water sample.
3) To determine the Total Dissolved Solids of the given water/sewage sample
4) Determination of Hardness in water sample
5) Determination of turbidity of water supply system
6) Determination of chlorine demand and chloride residuals in water supply system
7) To determine Total Suspended Solids (TSS) of the given sewage sample.
8) To find out the Quantity of Dissolved Oxygen present in the given waste water /water sample
9) Determination of Biochemical Oxygen Demand (BOD) exerted by given wastewater sample.
10) Determination of Chemical Oxygen Demand (COD) exerted by given wastewater sample

Reference:

Books

1) Kadiyali L. R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997.
2) Khanna, S. K. and C.E.G. Justo Highway Engineering Nem Chand and Bros, Roorkee, India, 2001.
3) Ministry of Road Transport and Highways. Specifications for Road and Bridge Works,
4) Papacostas C. S. and P D Prevedouros Transportation Engineering and Planning, Third Edition. Prentice Hall of India Pvt. Ltd, New Delhi, India, 2002.
5) Environmental engineering: Wastewater engineering, SK Garg, Khanna Publishers
6) Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd.
7) Water Supply Engineering by Dr. B.C. Punmia, Laxmi Publications Pvt. Ltd
8) Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill

MOOC Courses:

1) NPTEL >> Civil Engineering >> Water and Waste Water Engineering (Video) >>
2) https://nptel.ac.in/courses/120108005/
3) https://nptel.ac.in/courses/105/107/105107067/
4) https://nptel.ac.in/courses/105/101/105101008/
5) https://nptel.ac.in/courses/120/108/120108005/
6) https://nptel.ac.in/courses/105/103/105103205/
7) https://swayam.gov.in/nd1_noc20_ce23/preview
8) https://swayam.gov.in/nd1_noc19_ce32/preview

Websites (related to the course)

1) http://www.cpcb.nic.in/
2) http://www.rpcb.rajasthan.gov.in
3) http://www.bis.org.in/
4) http://www.who.int/en/
5) http://www.moef.gov.in/
6) https://nhai.gov.in/
7) http://mohua.gov.in/
8) http://smartcities.gov.in/content/

Economics and Finance for Engineers
Course Code: IL1203
B.Tech- VII Semester (Open Elective)

COURSE CREDITS: 4
SESSION DURATION: 60 MINUTES

COURSE DESCRIPTION:

This course aims to develop the management and business perspective among the students and its interaction with technology. The course has been divided in two parts Economics and Finance. Economics is the study of the way people and societies use limited resources in decision making. The world economies are becoming increasing market oriented and has faced many financial crises in the last decades. Thus, understanding about the truths of economics has become even vital in the affairs of people and nations. This part helps the students in understanding the regular uptrend and downturn in the economy and enables them to do appropriate business decision. Finance is also considered as life blood of any organization. Understanding the basics behind financial decision making is necessary for any individual irrespective of his/her profession. Therefore, it is imperative for every individual to understand the basic financial terms and concepts to grasp the nuances of the financial world. This part offers more analytical input than the knowledge of accounting process and finance, which is just a means to achieve the major objective of developing analytical and interpretation skills.

COURSE OUTCOMES

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

- IL1203.1. Apply the different concepts, theories of macroeconomic in understanding economic environment.
- IL1203.2. Outline the money market dynamics in economy and role in determination of interest rate.
- IL1203.3. Analyze and evaluate the basic problems of an economy which have been faced by the countries and policy makers over time like achieving high rate of growth, controlling inflation, preventing business cycles and solving problems of unemployment and poverty.
- IL1203.4. Explain the ripple impact of open economy.
- IL1203.5. Recognize elements of financial statements
- IL1203.6. Critically analyze financial statements for decision making and assess financial performance & position of organizations.
- IL1203.7. Evaluate viability of projects and proposals of capital nature.

TOPICS TO BE COVERED:

Economics:
In Introduction of Major Macro Economic Variables
Demand and Supply of Money
Business cycles
Inflation and unemployment
Monetary and Fiscal policy
Open Economy Macro Economics: Basic Concepts
Case Studies
Finance:
Building Blocks of Accounting & Finance
Financial Accounting: Reading and Interpretation of Financial Statements
Basic Principles of Financial Valuations
Corporate Financing Decision- Appraisal of a Project (Investment Decision)

BOOKS FOR REFERENCE

- Dwivedi, D. N. (2018). Macroeconomics: Theory and policy. New Delhi: Vikas Publishing House Pvt. Ltd.
- T. R. Jain (2017). Macroeconomics. New Delhi: V K Publications
- Edward Shapiro (2017). Macroeconomic Analysis. New Delhi: Galgotia Publications
- Batra, K.J. (2019). Accounting and Finance for Non-Finance Managers. Sage Publications.
- Chandra, P. (2017). Finance Sense: Finance for Non-Finance Executives. Mc-Graw Hill Education.
- Narayanaswamy, R. (2014). Financial Accounting – A managerial perspective (6th edition) by PHI Learning Private Limited.
- Gupta, A. (2008). Financial Accounting for Management - An Analytical Perspective (3rd edition) by Pearson Education.

ASSESSMENT MATRIX

The criteria for assess the learning outcomes of this course are as follows:

S.No.	Specification	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	20
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	40
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil

11	Project-I	40
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total	**100**

Course Title and Code: Disaster Management CE1206	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B. Tech Sem VI sem (2017-2021) (OE)
Course Objective: This course aims to develop understanding of various natural and manmade disasters. Natural disasters include earthquake, Tsunami, Flood, forest fires and Land Slides. Manmade disasters include fire, Industrial Pollution, embankment failure, structural failure and due to electric supply. Topics includes the causes for these disasters and remedial measures which can minimize the losses to the life and property. The course also includes the identification and description of electric supply resilience and restoration.	

Course Outcomes

On completion of the course, the student should be able to:

CE1206.1. Asses the types of disasters, causes and their impacts.

CE1206.2. Assess vulnerability and various methods of risk reduction measures and mitigation.

CE1206.3. Draw the hazard and vulnerability profile of a given region.

CE1206.4. Analyze a power grid collapse.

CE1206.5. Plan and execute framework to black start and restoration procedure with considering security criteria and power system reliability.

Prerequisites			
Teaching Scheme (Hours per Week)		3 0 2	
Credits		4	
Sr. No.	**Evaluation Component**	**Marks**	
1	Attendance	Nil	
2	Assignment (5 Nos)	15	
3	Class Participation	Nil	
4	Quiz	10 (1 Quiz)	
5	Theory Exam-I	15	
6	Theory Exam-II	Nil	
7	Theory Exam-III	30	
8	Report-I/ Case Study	10	
9	Report-II/Case Study	10	
10	Report-III/Case Study	10	
11	Project-I	Nil	
12	Project-II	Nil	
13	Project-III	Nil	
14	Lab Evaluation-I	Nil	
15	Lab Evaluation-II	Nil	
16	Course Portfolio	Nil	
	Total	100	
Evaluation scheme for retest			
	Theory Exam III	30	

Syllabus (Theory)

Unit-1 Introduction to Disasters, Various types of disaster, Natural: Flood, Earthquake, cyclone, Land slide, Manmade: Fire, Industrial Pollution, embankment failure, structural failure and due to electric supply. Loss of resources.

Unit-2

Risk and Vulnerability:

Risk: Its concept and analysis, Risk reduction, Vulnerability: Its concept and analysis, strategic development for vulnerability reduction

Unit 3

Disaster Management in Power Utilities and Power grid collapse:

Sectoral impacts, System Impact of the Loss of Major Components, Vulnerability Program, Options to reduce impacts of disaster, Power system operation security, Security criteria, System security function, Power System Reliability, Black start and restoration Procedure, Black start facilities, Impact of Blackout in day to day life, Role of Utility staff, Speeding recovery

Unit – 4

Management- Objectives, Processes, Events, analysis, base-line data, forecasting and Warnings. Disaster preparedness plan concept and nature, Emergency operation center and IT aids- physical environment, Applications. Public-private agency co-ordination- federal, state and local disaster response organization and network, Citizen and community role in disaster response and recovery.

Syllabus (Practical)

1. A Case study on flood Hazard
2. A case study on Tsunami Hazard
3. A case study on Earthquake
4. A case study on Forest fire
5. A case study on structural failure
6. A case study on grid challenges for Indian grid system on blackout plan (05 April 2020)
7. A case study on Indian blackout on July 30-31, 2012

Text /Reference Books:

1. M. Pandey, "Disaster Management" Wiley India Pvt. Ltd.
2. Tushar Bhattacharya, "Disaster Science and Management" McGraw Hill Education (India) Pvt. Ltd.
3. Crisis and disaster management plan for power sector by central electricity authority of India
4. N. Malla, S. Poudel, N. R. Karki and N. Gyawali, "Resilience of electrical power delivery system in response to natural disasters," 2017 7th International Conference on Power Systems (ICPS), Pune, 2017, pp. 806-811.doi: 10.1109 /ICPES.2017.8387400
5. Sahni, Pardeep et. al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.

Course code	Course Name	Teaching Scheme			
		L	T	P	Credits
AS1203	**Optimization Techniques**	**3**	**0**	**2**	**4**

Course Objectives:

This course aims to give knowledge about algorithms and methods developed for solving various types of optimization problems that arise in engineering and industries.

In this course, each student will explore how to formulate mathematical models of optimization problems, and how to solve them effectively using various software.

Course Outcomes:

On successful completion of this course, the students will be able to

AS1203.1. formulate linear programming models with respect to industrial or societal issues such as production, transportation, job assignment, health care etc.
AS1203.2. solve and analyze linear and non-linear programming problems using simplex method, MODI method, Hungarian method, Lagrange's method, etc.
AS1203.3. find optimized solutions for industry and service sector related problems using queueing theory, game theory and sequencing theory.
AS1203.4. solve optimization problems using various software support like Windows-based TORA, Excel spreadsheet templates and MATLAB.

Syllabus (Theory):

Unit – I: Introduction: Introduction to Optimization and its scope, formulating a Mathematical Model, Deriving Solutions from the Model.

Unit – II: Linear Programming Problems: Revised Simplex Method, Duality Theory and Sensitivity Analysis, Dual Simplex Method, Transportation Problem, Assignment Problem.

Unit – III: Non-Linear Programming Problems

Introduction, Single variable and Multi-variable Optimization, Constrained and Unconstrained Problems, Kuhn-Tucker conditions, Dynamic Programming.

Unit – IV: Queuing and Inventory Theory

Basic structure of Queuing models, Role of the exponential distribution, Birth and Death processes, Queuing models based on birth and death processes (M/M/1 Model).

Unit – V: Game and Sequencing Theory:

Game Theory**,** Johnsons Algorithm for n Jobs and two Machines, n Jobs and three Machines, Two Jobs and m Machines Problems.

Syllabus (Practical):

Problem solving using various software packages for the following

- Linear Programming problems
- Non-linear Programming problems
- Case Study

Evaluation Scheme:

Sr. No	Specifications	Evaluation Scheme
1	Attendance	-
2	Assignment	20
3	Class Participation	10
4	Quiz	20
5	Theory Exam-1	10
6	Theory Exam-2	-
7	Theory Exam-3	30
8	Report-1	-
9	Report-2	-
10	Report-3	-
11	Case Study - 1	-
12	Case Study - 2	-
13	Project -3	-
14	Lab Evaluation-1	10
15	Lab Evaluation-2	
16	Course portfolio	
	Total (100)	**100**
17	Retest - Theory Exam-3	30

Text/Reference books:

1. Hillier F.S. and Lieberman G.J., ***Introduction to Operations Research: Concepts and Cases***, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.

2. Taha H. A, ***Operations Research: An Introduction***, Prentice-Hall of India, 7th ed., 2003.

3. Ronald L. Rardin, ***Optimization in Operations Research***. Pearson Education, First Indian Reprint 2002.

4. PantJ.C., ***Introduction to Optimization: Operations Research***, Jain Brothers, 5th Ed., 2000.

Course Title and Course Code	**Green Energy (IL1202)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech (Semester-VI)**

Course Objective:
The main objective of the course is: -

- To expose the students to different energy sources, solar energy, solar photovoltaic, biomass, wind, small hydro and other renewable energy resources
- To develop understanding of conversion technologies, processes, systems and devices and equip the student to take up projects in those areas.

Course Outcomes:
On successful completion of this course, the students should be able to:

IL1202.1. Identify suitable renewable source and technology for a given requirement
IL1202.2. Use interdisciplinary approach for designing solar energy systems, predicting performance with different systems
IL1202.3. Design solar energy systems for making the process economical, environmentally safe and sustainable.
IL1202.4. Identify the major sources of biomass energy and apply the various technologies to generate biomass energy.
IL1202.5. Assessing the hydro power potential of a basin and design the various types of turbines to generate hydro power.

Prerequisites		**NIL**
Sr. No	**Specifications**	**Marks**
1	Attendance	
2	Assignment	10
3	Class Participation	
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	
7	Theory Exam-III	30
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	30
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	
15	Lab Evaluation-II	10
16	Course Portfolio	
Total (100)		**100**
Evaluation Scheme for Retest		**30**
1	Theory Exam Re-test	30
	Total (30)	**30**

UNIT-I Energy Sources and Sustainability (10 Hours)

Energy chain and common forms of usable energy - Present energy scenario - World energy status - Energy scenario in India - Introduction to renewable energy resources – Sustainability, Triple bottom line, sustainable smart city.

UNIT-II Biomass Energy (10 Hours)

Biomass as energy resources; Bio energy potential and challenges-Classification and estimation of biomass; Source and characteristics of biofuels: Biodiesel, Bioethanol, Bio petrol, Biogas; Types of biomass energy conversion technologies; waste to energy conversions; Biomass resource development in India; Future of Biomass energy in India & Global Scene; Environmental benefits.

UNIT-III Solar Energy

Solar Energy, Solar cell, I-V characteristic, cell efficiency, Current status and Future potential of P.V. cells, Solar Thermal systems, Application of solar energy, Design and installation of solar panels for residential and industrial applications, solar power generation systems (a) off-grid systems (b) grid connected systems (c) power control and management systems, Energy Storage devices, Environmental impact, economics of solar energy systems.

UNIT-IV Hydro Power Energy (10 Hours)

Hydro power energy, types of hydropower plants and schemes, runoff studies, assessment of hydropower potential of a basin, storage and pondage, load studies, elements of hydropower plants, types of power houses, low head turbines

Textbooks:

1. S. P. Sukhatme, J. K. Nayak, "Solar Energy" McGraw Hill Education, 2017
2. G. D. Rai, Non-conventional Sources of Energy, Khanna Publishers, Delhi, 2012.
3. D. P. Kothari, K. C. Singal, and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies" PHI, 2011.
4. John Andrews, Nick Jelley (2013), Energy Science: Principles, technologies and impacts, Oxford Universities press.
5. 1- Renewable energy technologies: A practical guide for beginners by Chetan S Solanki; PHI; ISBN: 978-81-203-3434-2
6. 2- Renewable energy Engineering and Technologies: by VVN Kishore; Teri Press; ISBN:978-81-7993-221-6
7. Water Power Engineering, M.M. Dandekar& K.N. Sharma, Dhanpat Rai & Sons

Reference Books:

1. Fang Lin You, Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press.
2. John. A. Duffie, William A. Beckman (2013), Solar Engineering of Thermal processes, Wiley
3. A. R. Jha (2010), Wind Turbine technology, CRC Press.
4. Godfrey Boyle (2012), Renewable Energy, power for a sustainable future, Oxford University Press.
5. Recovering Energy from Waste Various Aspects Editors: Velma I. Grover and Vaneeta Grover, ISBN 978-1-57808-200-1; 2002

Course Title and Course Code	**Mechatronics and Robotics (IL1201)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI**

Course Objective:
To provide understanding of robots & manipulators in different fields of application, also to synthesis planar & spatial manipulator and its control strategy.

Course Outcomes:
On successful completion of this course, the students will be able to:

- IL1201.1. identify the use of robots and its application in industry and everyday life.
- IL1201.2. analyze kinematic parameters for different robots.
- IL1201.3. analyze dynamic parameters for robots and method to improve its performance including energy requirements.
- IL1201.4. develop open and close loop control system for a manipulator.
- IL1201.5. perform trajectory planning for a manipulator.

Prerequisites		Basics of Physics
Sr. No	**Specifications**	**Marks**
1	Attendance	
2	Assignment	10
3	Class Participation	
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	
7	Theory Exam-III	30
8	Report-I	20
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (End Term)	10
16	Course Portfolio	
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	50
Total		**50**

COURSE SYLLABUS (Theory):

UNIT - I

Introduction:

Robotics trends and the future, robot anatomy – links, joints and joint notation scheme, Degrees of Freedom (DOF), required DOF in a manipulator, arm configuration, wrist configuration; end-effector, human arm characteristics, design & control issues, manipulation & Control, robotics sensors, robot specification, different robot programming platform.

UNIT - II

Robot Motion Analysis:

Introduction to co-ordinate frames mapping, mapping between rotated frames, mapping between translated frames, description of objects in space, transformation of vectors - rotation & translation of vectors, composite transformations, inverting a homogeneous transform, fundamental rotation matrices – principle axes rotation fixed, euler and equivalent angle axis representations.

Kinematics Manipulators:

The kinematic modeling of manipulator, direct kinematics, Denavit – Hartenberg notation, kinematic relationship between links, manipulator transformation matrix, the inverse kinematics manipulator: workspace, solvability of inverse kinematic model, singularities of manipulators.

UNIT – III

Differential Motion, Statics:

Linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, mapping velocity vectors, velocity propagation along links. manipulator Jacobian, Jacobian inverse, Jacobian singularities, static analysis. Jacobian in statics.

Dynamics: Introduction, Lagrangian mechanics, Lagrange – Euler formulation, velocity of a point on the manipulator, the inertia tensor, the kinetic energy, the potential energy. equations of motions, the Lagrangian-Euler (LE) dynamic model algorithm.

UNIT – IV

Robot Control:

Open loop, close loop system, and differential equation, control of movements of mechanical joints, control sequence, n-joints manipulator control system, system performance, control system with damping, control strategy, architecture of control systems.

UNIT – V

Trajectory Planning: Definition and planning tasks, joint space techniques, cartesian space techniques, joint space versus cartesian space tp.

Machine Vision: Introduction to machine vision, industrial application of vision controlled robotic systems, image processing and analysis, description of other components of vision system.

COURSE SYLLABUS (Practical):

1. To determine the forward kinematic of a 1-DOF robot using RoboAnalyzer
2. To determine the forward kinematic of a 3-DOF robot using RoboAnalyzer
3. To determine the forward kinematic of a 6-DOF robot using RoboAnalyzer
4. To determine the inverse kinematic of a 1-DOF robot using RoboAnalyzer
5. To determine the inverse kinematic of a 3-DOF robot using RoboAnalyzer
6. To determine the forward dynamic of a 3-DOF robot using RoboAnalyzer
7. To determine the inverse dynamics of a 3-DOF robot using RoboAnalyzer
8. To determine the trajectory control of a 3-DOF robot using RoboAnalyzer
9. To determine the trajectory control of a 6-DOF robot using RoboAnalyzer
10. To write a MATLAB program to interface camera for data acquisition.
11. To write a MATLAB program to determine pattern in an image.

Textbooks:

1. Saha, Subir Kumar. Introduction to robotics. Tata McGraw-Hill Education, 2014.
2. Mittal, R. K., and I. J. Nagrath. Robotics and control. Tata McGraw-Hill, 2003.

3. Fu, King Sun, Ralph Gonzalez, and CS George Lee. Robotics: Control Sensing. Vis. Tata McGraw-Hill Education, 1987.
4. Waldron, Kenneth J., Gary L. Kinzel, and Sunil K. Agrawal. Kinematics, dynamics, and design of machinery. John Wiley & Sons, 2016.
5. Groover, Mikell P., Mitchell Weiss, and Roger N. Nagel. Industrial robotics: technology, programming and application. McGraw-Hill Higher Education, 1986.
6. Schilling, Robert J. Fundamentals of robotics: analysis and control. Vol. 629. New Jersey:

Prentice Hall, 1990.

Course Title and Code: Excel Skills for Business: CS1410	
Hours per Week	**Curated MOOC (approx. 4 hrs. per week)**
Credits	**4**
Students who can take	**B.Tech. (ECE/EE/ME/CE) Open Elective**

Course Objective: This course intended to develop one of the most critical and fundamental digital skills today. Spreadsheet software remains one of the most ubiquitous pieces of software used in workplaces across the world. Learning to confidently operate this software means adding a highly valuable asset to student's employability portfolio.

Course Outcome:

On successful completion of this course, the students should be able to:

- CS1410.1. Develop advanced Excel Skills for Business.
- CS1410.2. Design sophisticated spreadsheets, including professional dashboards, and perform complex calculations using advanced Excel features and techniques.
- CS1410.3. Students will acquire the skills to manage large datasets efficiently, extract meaningful information from datasets, present data and extract information effectively.
- CS1410.4. Analyze data and present the results in a user-friendly way. Create charts and tables that effectively summarize raw data.
- CS1410.5. Validate data and prevent errors in spreadsheets, create automation, apply advanced formulas and conditional logic to help make decisions and create spreadsheets that help forecast and model data.

erequisites: NA

aluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	40
3	Class Participation	Nil
4	Quiz	20
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	Nil
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	20
15	Lab Evaluation2	20
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Quiz	20
2	Lab Evaluation2	20

Course Contents:

1. Excel Basics
2. Work with Cells and Worksheets
3. Calculate Your Data
4. Format your Workbook
5. Add Charts and Graphics
6. Collaborate with Others
7. Analyze your Data
8. Work with Macros and the Web

Suggested Reading Materials:

BOOKS AND REFERENCES

- Walkenbach, John. MICROSOFT EXCEL 2007 BIBLE (With CD). John Wiley & Sons, 2007.
- Walkenbach, John. Excel charts. John Wiley & Sons, Inc., 2002.
- Walkenbach, John. Excel 2010 bible. Vol. 593. John Wiley & Sons, 2010.
- Bourg, David M. Excel Scientific and Engineering Cookbook: Adding Excel to Your Analysis Arsenal. " O'Reilly Media, Inc.", 2006.
- Simon, Jinjer L. Excel programming: your visual blueprint for creating interactive spreadsheets. Wiley, 2005.
- Walkenbach, John. Microsoft Excel 2000 power programming with VBA. John Wiley & Sons, Inc., 1999.
- Bloch, Sylvan Charles. Excel for engineers and scientists. John Wiley & Sons, Inc., 1999.

This course would be delivered on COURSERA from 27th July, 2020 to 17th December, 2020 by Prof. Nicky Bull, Dr Prashan S. M. Karunaratne, and A/Professor Yvonne Breyer, **Macquarie University, Sydney, Australia**

Course Title and Code: Building Planning & Design **CE1205**	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B.Tech Semester-VI (Batch: 2017-2021)/ C**
Course Objective: This course aim to develop understanding of the fundamental principle and concepts of building planning & drawing as per building by-laws and standard national building code.	
Course Outcomes: On successful completion of this course students will be able to: CE1205.1. Interpret conventional sign, symbols and working drawings of buildings. CE1205.2. Prepare line plans of residential, commercial and public buildings using principle of planning. CE1205.3. Plan and design earthquake resistant buildings. Comply with the building by-laws as per provision of local bodies and NBC technical specification.	
Prerequisites	NA

Syllabus (Theory)

Unit 1: Introduction to buildings, Type of buildings, Principles of building planning, Principles of architecture composition building by–laws as per National Building Code, Standards for residential buildings, Building by–laws of local authority, standards for industrial, public, commercial and institutional buildings.

Unit 2: Planning of earthquake resistant building considering symmetry, simplicity, continuity, consideration of locating staircase and overhead water tank, most sensitive to earthquake.

Unit 3: Introduction of Building Services like water supply, sewerage and drainage systems, sanitary fittings and fixtures, plumbing systems, principles of internal & external drainage systems, principles of electrification of buildings, intelligent buildings, elevators & escalators their standards and uses ,air-conditioning systems, firefighting systems, building safety and security systems, ventilation and lightening and staircases, fire safety, thermal insulation

Unit 4: Perspective Drawing and Town Planning-Elements of perspective drawing involving simple problems, one point and two-point perspectives, energy efficient buildings. Concepts of master plan, structure plan, detailed town planning scheme and action plan, estimating future needs planning standards for different land use, allocation for commerce, industries, public amenities, open areas etc., planning standards for density distributions, density zones, planning standards for traffic network, standard of roads and paths, provision for urban growth, growth models, plan implementation, town planning legislation and municipal acts.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CE732	Ground Improvement Techniques	3	0	2	0	4

Evaluation Scheme (Theory)						Evaluation Scheme (Practical)				
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation	Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation	Additional Continuous Evaluation*	Total Marks

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Introduction: Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement, Shallow and deep compaction requirements, Principles and methods of soil compaction.
Mechanical Stabilization: Shallow compaction and methods, Properties of compacted soil and compaction control, Deep compaction and Vibratory methods, Dynamic compaction.
Hydraulic Modification: Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, vacuum consolidation, Electro-kinetic dewatering, design and construction methods.
Modification by Admixtures: Cement stabilization and cement columns, Lime stabilization and lime columns, Stabilization using bitumen and emulsions, Stabilization using industrial wastes. Construction techniques and applications.
Grouting: Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.
In Situ Soil Treatment Methods: Soil nailing, rock anchoring, micro-piles, design methods, construction techniques, Case studies of ground improvement projects.
Indian Standard Codes for Ground Improvement Technology (IS 13904, IS 5284, etc.)
Ground Improvement Technologies for a Sustainable World

Textbooks:

1. Koerner R.M., “Construction and Geotechnical Methods in Foundation Engineering”, McGraw-Hill, 1994.
2. Purushothama Raj, P. “Ground Improvement Techniques”, Tata McGraw-Hill Publishing Company, New Delhi, 1995

Reference Books

1. Moseley M.P., Ground Improvement Blockie Academic and Professional, Chapman and Hall, Glassgow, 1993.
2. Jones J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1995.
3. Koerner, R.M., “Design with Geosynthetics”, (3rd Edition) Prentice Hall, New Jersey, 2002
4. Jewell, R.A., “Soil Reinforcement with Geotextiles”, CIRIA special publication, London, 1996
5. Das, B.M., “Principles of Foundation Engineering”, Thomson Books / Cole, 2003.

Course Title and Course Code	Advanced Foundation Engineering, CE1210
Hours per week	L T P: 3 0 2
Credits	4
Students who can take	B.Tech, Semester-VII (Batch: 2017-2021)
Prerequisites	Basics of Geotechnical Engineering

Course Objective:

To introduce students to the fundamental concepts of soil exploration techniques, slope stability analyses, lateral earth pressure theories and bearing capacities of shallow and deep foundations.

Course Outcomes:

On successful completion of this course, the students should be able to:

CE1210.1. apply appropriate soil exploration technique necessary for site investigation.

CE1210.2. evaluate lateral earth pressure by applying several earth pressure theories for cohesionless and cohesive soils.

CE1210.3. analyze and determine the nature of slope based on slope stability analyses.

CE1210.4. evaluate the bearing capacity of soil and adopt appropriate foundation type for sandy and clayey soils.

Sr. No	Specifications	Marks
1.	**Attendance**	-
2.	**Assignment (5 Nos.)**	**20**
3.	**Class Participation**	**5**
4.	**Quiz (5 Nos.)**	**15**
5.	Theory Exam-I	-
6.	**Theory Exam-II**	**15**
7.	**Theory Exam-III**	**25**
8.	Report-I	-
9.	Report-II	-
10.	Report-III	-
11.	**Project-I (Based on the application of Lab Experiments)**	**10**
12.	Project-II	-
13.	Project-III	-
14.	Lab Evaluation-I	-
15.	**Lab Evaluation-II**	**10**
16.	Course Portfolio	-
	Total	**100**

Retest:

Sr. No	Specifications	Marks
1.	Theory Exam-III	25

Syllabus (Theory):

Unit I	**Soil exploration:** Purpose and planning, boring methods, soil sampling, observation of ground water tables, standard penetration tests, cone penetration tests, coring of rocks, geophysical exploration.
Unit II	**Slope stability analysis:** Infinite and finite slopes, earth and rockfill dams, filter criteria.
Unit III	**Lateral earth pressure:** Introduction, earth pressure at rest, active and passive earth pressures, Rankine's and Coulomb's theories, graphic solution for Coulomb's active earth pressure, cantilever and anchored sheet pile walls, braced cuts.
Unit IV	**Shallow foundations:** Bearing capacity: general concepts, Terzaghi's theory, effect of groundwater table, the general bearing capacity equation, eccentrically loaded foundations, plate load tests, foundation settlements.
Unit V	**Deep foundations:** Piles, types, bearing capacity of single pile and pile groups, pile load tests, settlement of piles, negative skin friction; Shaft and caisson foundations. Foundations on expansive soils; Elements of machine foundations; Laterally loaded piles-Cantilever method.

Laboratory Experiments:

Sl. No.	List of Experiments
1.	Permeability Test, Variable and Constant head
2.	Direct Shear Test
3.	Triaxial Test
4.	Vane Shear Test
5.	Standard Penetration Test
6.	Cone Penetration Test
7.	Consolidation Test

References:

1. Arora, K. R. (1992). *Soil Mechanics and Foundation Engineering in SI Units*. Standard Publishers Distributors.
2. Coduto, D. P. (1999). *Geotechnical Engineering: Principles and Practices*, Pearson.
3. Lambe, T. W., & Whitman, R. V. (2008). *Soil mechanics SI version*. John Wiley & Sons.

4. Murthy, V. N. S. (2002). *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*. CRC press.
5. Punmia, B., & Jain, A. K. (2005). *Soil Mechanics and Foundations*. Firewall Media.
6. Ranjan, G., & Rao, A. S. R. (2007). *Basic and Applied Soil Mechanics*. New Age International.
7. Singh, A., & Chowdhary, G. R. (1967). *Soil Engineering in Theory and Practice*. Asia Publishing House.
8. Venkatramaiah, C. (1995). *Geotechnical Engineering*. New Age International.

Online Resources:

1. **https://nptel.ac.in/courses/105/108/105108069/**
2. **https://nptel.ac.in/courses/105/105/105105039/**

Virtual Lab:

1. http://smfe-iiith.vlabs.ac.in/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CE1111	Earthquake Engineering	3	1	0	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	Mid Term Test - II	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation / Additional Continuous Evaluation*	Total Marks**

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Course Syllabi (Theory):

Elements of Seismology – General effects of an earthquake, terminology, structure of earth, causes of an earthquake, plate tectonic theory, seismic waves, magnitude and intensity, methods of measurement, energy released, seismograph, strong motion earthquakes, accelerogram, soil liquefaction, prominent earthquakes of India.

Free vibrations of single degree-of-freedom systems – Dynamic loads and dynamic analysis, degrees of freedom, Undamped free vibrations, multiple elastic forces, viscously damped vibrations, equations of motion and solution, logarithmic decrement.

Forced vibrations of single degree-of-freedom systems – Forced vibrations (harmonic loading) of single degree of freedom systems. Undamped and viscously damped vibrations, equations of motion and solution, Force transmitted to foundation, transmissibility, response to harmonic support excitations.

Response spectrum theory: Response to general dynamic loading, Duhamel's integral, rectangular and triangular loading, Earthquake response spectrum, tripartite spectrum, construction of design response spectrum, effect of foundation and structural damping on design spectrum.

Principles of earthquake resistant design – Sustainable design aspect in earthquake resistance buildings, Planning aspects, symmetry, simplicity, regularity. Resistance of structural elements and structures for dynamic load, design criteria, strength and deflection.

Evaluations of Seismic Forces – Philosophy of earthquake resistant design, Provisions of IS 1893, Soft storey, Design spectrum of IS 1893, evaluation of lateral loads due to earthquake on multistory buildings.

Ductile detailing of RCC members- Concept of ductility, different ways of measuring ductility, factors affecting ductility, energy absorption, provisions of IS 13920.

SDOF Systems Subjected to General Dynamic Loading: Duhamel's integral, Application to simple loading cases, numerical evaluation of response integral, Piece wise exact method, Newmark's-Beta method.

Free Vibration Analysis of MDOF systems – I: MDOF systems, selection of DOFs, formulation of equations of motion, Stiffness matrices, Static condensation, Free Vibration as Eigen Value problem, Frequencies and Mode Shapes, Determination of natural frequencies and mode shapes by Stodola- Vianello method, Orthogonality conditions.

.

Textbooks:

1. Dynamics of Structures –A.K. Chopra
2. Structural Dynamics - Mario Paz CBS Publication
3. Earthquake Resistant Structures –D.J. Dowrick John Wiely Publication
4. Dynamics of Structures – R. M. Clough and Penzian , McGraw Hill co.New Delhi

5. Mechanical Vibrations – G. R. Grover Roorkee University, Roorkee
6. Analysis and Design of Foundations for Vibrations – P. J. Moove. Oxford and I. B. H. Publication, Delhi

Reference Books:

1. Foundation Design Manual – N. V. Nayak, Dhanpatrai and sons, Delhi
2. Manual of Earthquake Resistant Non-Engineering Construction, University of Roorkee
3. Elements of Earthquake Engineering – Jai Krishna, South Asian Pub.New Delhi
4. Earthquake Resistant, Design of Masonry and Timber Structures – A.S. Arya

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="3">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>CE510</td><td colspan="3">Hydrology and Water Resources Engineering</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
</table>

<table>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="4">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test - I</td><td>Mid Term Test - II</td><td>End Term Test</td><td>Class Participation / Additional Continuous Evaluation*</td><td>Total Marks</td><td>Mid Term Test - I</td><td>End Term Test</td><td>Class Participation / Additional Continuous Evaluation*</td><td>Total Marks**</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Course Syllabi (Theory):

Hydrologic cycle - rainfall and its measurement - computation of mean rainfall over a catchment area using arithmetic mean, Theissen polygon and Isohyetal methods - Runoff -infiltration indices - Storm Hydrograph and unit hydrograph River regions and their characteristics - classification of rivers on alluvial plains - meandering of rivers – Design of river training works with IS codes. Sustainability of Water Resources: Consumptive use of surface Water and Ground Water, Importance of Water Harvesting, Water recycling

Reservoir planning - Investigations - zones of storage in a reservoir - single purpose and multipurpose reservoir - determination of storage capacity and yield - reservoir sedimentation - Reservoir life - Sediment prevention - Flood estimation- Flood forecasting - Flood routing.

Ground water - types of aquifers - storage coefficient - coefficient of transmissibility - steady radial flow into a well located in an unconfined and confined aquifer - Tube wells and Open wells. Yield from an open well.

Water logging - causes and effects of water logging - remedial measures - land reclamation - land drainage - benefits - classification of drains - surface drains - subsurface drains - design principles and maintenance of drainage systems.

Textbook(s)/ Reference Book(s)

1. Punmia, B.C., Irrigation and Water Power Engineering, Standard Publishers, 2001.
2. Ragunath. H.M., Hydrology, Willey Eastern Limited, New Delhi, 2000.
3. Subramanya, Engineering Hydrology, Tata-McGraw Hill, 2004.

Reference:

1. Ven Te Chaw, Maidment – Applied Hydrology, Tata Mc Graw Hill Publisher, 2001.

Course Title and Course Code	Integrated Waste Management for Smart Cities CE1207
Hours per week	L T P: 3 1 0
Credits	03
Students who can take	B. Tech VII Semester (DE)
Prerequisites	Environmental Sciences, Basics of Environmental Engineering

Course Objective: The objective of this course is to provide a broader understanding on various aspects of Integrated solid waste management practiced w.r.t. smart cities. The environmental impact of waste management and its relationship on the big picture sustainable development and smart city development will be discussed.

Course Outcomes: On successful completion of course, student will able to:

- CE1207.1. Examine the technical issues that are required to set up a solid waste management system
- CE1207.2. Make route optimization for a solid waste collection and transport system.
- CE1207.3. Setup waste processing technologies and recycling system
- CE1207.4. Design a sustainable integrated solid waste management system based on multiple criteria
- CE1207.5. Apply the various government regulations, standards for integrated solid waste management.

Evaluation Scheme:

Sr.No	**Specifications**	**Marks**
1.	Attendance	Nil
2.	Assignment (04)	20
3.	Class Participation	10
4.	Quiz (02)	10
5.	Theory Exam-I	Nil
6.	Theory Exam-II	15
7.	Theory Exam-III	25
8.	Report-I	20
9.	Report-II	Nil
10.	Report-III	Nil
11.	Project-I	Nil
12.	Project-II	Nil
13.	Project-III	Nil
14.	Lab Evaluation-I [Continuous evaluation]	Nil
15.	Lab Evaluation-II	Nil
16.	Course Portfolio	Nil
	Total	**100**

Evaluation Scheme for Retest

Sr. No	**Specifications**	**Marks**
1	Theory Exam-III	25

COURSE SYLLABUS (Theory):

UNIT-01

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management, MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program.

UNIT-02

Waste generation rates, Composition, Hazardous Characteristics – TCLP tests – waste sampling Source reduction of wastes, Recycling and reuse. Handling and segregation of wastes at source, storage and collection of municipal solid wastes, Analysis of Collection systems, Need for transfer and transport, Transfer stations, labeling and handling of hazardous wastes.

UNIT-03

Waste processing, processing technologies, biological and chemical conversion technologies, Composting - thermal conversion technologies, energy recovery, incineration, solidification and stabilization of hazardous wastes, treatment of biomedical wastes.

UNIT-04

Construction and Demolition (C&D) Waste Management –Overview, Electronic Waste (E-Waste) Management – Issues and Status in India, Disposal of waste in landfills.

UNIT-05

Current Issues in Solid Waste Management, Review of MSW Management Status in Smart Cities in the Country, Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes, C&D Waste Regulations, Globally E-Waste Management Rules 2016

UNIT-06:

Wastewater treatment, sewage and effluent, sources of wastewater, classification of wastewater, pollutions, characteristics and testing of sewage, composition, sampling, physical and chemical analysis, Sewage treatment Plant (STP), Sludge management.

Reference books:

1. Tchobanoglous, G., Theisen, H., & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill, New York
2. Solid Waste Engineering, Principle & Management issues by VenTe Chow
3. Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developing countries.
4. Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.
5. Guidelines for Management and Handling of Hazardous wastes MOEF (1991), Govt. of India.
6. Datta, M; Waste Disposal in Engineered Landfills, Narosa Publishers, Delhi.
7. OP Gupta, Elements of Solid Hazardous Waste and Management, Khanna Publishing House.
8. Waste Management "Asian and Pacific Center for Transfer of Technology (N.D.) India", September 1993.
9. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
10. William A Worrell and P. Aarne Veslind Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)
11. MSW Management Rules 2016, Govt. of India, available online at CPCB website.
12. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website

MOOC Courses:

1) https://nptel.ac.in/courses/105/105/105105160/
2) https://swayam.gov.in/nd2_ugc19_bt18/preview
3) http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/281

Websites (related to the course)

1) http://www.cpcb.nic.in/
2) http://www.rpcb.rajasthan.gov.in
3) http://www.bis.org.in/
4) http://www.who.int/en/
5) http://www.moef.gov.in/
6) http://smartcities.gov.in/content/

Course Title and Code: Design of Advanced Concrete Structures (CE 1208)	
Hours per Week	**3 1 0**
Credits	**4**
Prerequisite	Basic concepts of RCC Design
Students who can take	**B.Tech Semester-VII (Batch: 2017-21)/ DE**

Course Objective:
This course aims to develop understanding about design of concrete structures such as continuous beams, staircases, columns, column footings, retaining walls and concept of pre-stressing in concrete structures.

Course Outcomes:

On successful completion of this course, students will be able to:

CE1208.1. design staircases.

CE1208.2. design continuous beams.

CE1208.3. design columns and column footings.

CE1208.4. design retaining walls.

CE1208.5. analyze the pre-stressed concrete beams in flexure and sustainable concrete for construction.

Evaluation Scheme		
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignments (04 Nos)	20
3	Class Participation	NIL
4	Quiz (04 Nos)	20
5	Theory Exam-I	NIL
6	Theory Exam-II	15
7	Theory Exam-III (End term)	25
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	10
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
	Total (100)	100

Retest: Theory Exam: 25

Course Syllabus:

Design of Staircases: Loads & load effects on staircases, design of stairs spanning horizontally and dog-legged stairs.

Design of Continuous Beams: Effective span, span/depth ratio, BM & SF, design of continuous beams.
Design of Columns: Effective length, code requirements on slenderness limits, minimum eccentricity & reinforcement, design of short columns under axial compression.
Design of Column Footings: Types of footings, general design consideration and code requirements, design of isolated rectangular and square column footings.
Design of Retaining Walls: Types, forces and stability of retaining walls, design of retaining walls.
Pre-stressed Concrete: Introduction, basic concepts, classification and types of pre-stressing, Pre-stressing systems, analysis of beams for flexure, losses in pre-stress, Sustainable concrete construction.

References:

Text and reference books:

1. Reinforced concrete design, Limit state design, Ashok K. Jain, Nem Chand & Bros, Roorkee, 2002
2. Limit state design of reinforced concrete, B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 2016
3. Reinforced concrete design, S. N. Sinha, Tata Mc Graw Hill Education Pvt Ltd, New-Delhi, 2002
4. Reinforced concrete design, P. C. Varghese, Prentice-Hall of India, New Delhi, 2001
5. Advanced reinforced concrete design, N. Krishna Raju, CBS Publishers & Distributors Pvt Ltd, 3rd Edition, 2016
6. IS codes (IS 456, IS SP 16, IS 875)

Online references:

1. https://swayam.gov.in/nd1_noc20_ce39/preview
2. https://nptel.ac.in/courses/105/106/105106118/
3. https://www.slideshare.net/PraveenKumarShanmuga/design-of-columns-axial-load-as-per-is-4562000
4. https://www.slideshare.net/PraveenKumarShanmuga/design-of-footing-as-per-is-4562000?next_slideshow=1

Course Title and Code **Railway and Airport Engineering:** CE 1209	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B. Tech VII sem (2017-2021) (CE)
Course Objective: This course aims to develop understanding of civil works related to two major modes of transportation, railways and airways. Railway Engineering involves the planning, design, construction, operation and maintenance of railway lines. Airport engineering involves the design and construction of various facilities of an airport which are necessary for efficient working of the airways.	

Course Outcomes:

On completion of the course, the student should be able to:

CE1209.1. Design the cross sections for railway track.

CE1209.2. Analyze the impact of hauling capacity and speed on the design of track.

CE1209.3. Design the points, crossings and signals for railway tracks.

CE1209.4. Design the various components of Airports.

Evaluation Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment (5 No.)	20
3	Class Participation	5
4	Quiz (2)	10
5	Theory Exam-I	Nil
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	5
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	10
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	
	Evaluation scheme for retest	
	Theory Exam III	30

Syllabus (Theory)

RAILWAY ENGINEERING

INTRODUCTION: Role of railways in transportation, Indian Railways, Gauges and types, Typical cross sections-single and double line B G track in cutting, embankment and electrified tracks, Coning of wheels and tilting of rails, Rails-Functions-requirements—types and sections length- defects-wear-creep-welding-joints, creep of rails

SLEEPERS AND BALLAST: Functions, Types, Track fitting and fasteners-Dog spike, screw spike and Pandrol clip, -Fish plates-bearing plates, Calculation of quantity of materials required for laying a track-Examples, Tractate resistances and hauling capacity

GEOMETRIC DESIGN: Necessity, Safe speed on curves, Cant-cant deficiency-negative cant-safe speed based on various criteria, (both for normal and high speed tracks) Transition curve, Gradient and types, grade compensation, Examples on above.

POINTS AND CROSSING: Components of a turnout, Details of Points and Crossing, Design of turnouts with examples (No derivations) types of switches, crossings, track junctions Stations and Types, Types of yards, Signaling-Objects and types of signals, station and yard Equipment-Turn table, Fouling mark, buffer stop, level crossing, track defects, and maintenance.

AIRPORT ENGINEERING

INTRODUCTION: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose with examples.

RUNWAY- Basic runway length-Corrections and examples, Runway geometrics, Taxiway-Factors affecting the layout - geometrics of taxiway-Design of exit taxiway with examples, Visual aids- Airport marking – lighting-Instrumental Landing System.

Text /Reference Books:

1. Saxena S. C. and Arora S. P., A text book of Railway Engineering, Dhanpat Rai & Sons, New Delhi, 2017
2. Mundrey J S., Railway Track Engineering, McGraw Hill Publications
3. Agarwal M. M., Indian Railway Track, Jaico Publications, Bombay
4. Saxena S. C. Airport Engineering Planning and Design, CBS Publishers and Distributors, New Delhi, 2017
5. Khanna S. K., Arora M. G. and Jain S. S. Airport Planning and Design, Nem Chand Bros, Roorkee, 2016

Online Resources:

NPTEL course Transportation Engineering-II
https://nptel.ac.in/courses/105/107/105107123/#

Course Title and Code: Advanced Highway Engineering CE1211	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Prerequisite	Highway Engineering
Students who can take	**B.Tech Semester-VII (Batch: 2017-21)/ DE**

Course Objective:
This course aims to develop understanding about statistical analysis of traffic data & their application in traffic management and design of sustainable bituminous mixes. It also includes various measures to control noise and air pollution due to road traffic.

Course Outcomes:

On successful completion of this course, students will be able to:

CE1211.1. analyze traffic data by using various statistical methods.
CE1211.2. design traffic signals and rotaries.
CE1211.3. design hot mix asphalt as per IRC standards.
CE1211.4. utilize waste materials such as recycled asphalt pavement, plastic waste and various slags for the construction of sustainable bituminous roads.
CE1211.5. categorize the levels of air and noise pollution generated by the road traffic.

Evaluation Scheme		
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment (02 Nos)	10
3	Class Participation	10
4	Quiz (02 Nos)	10
5	Theory Exam-I	NIL
6	Theory Exam-II	15
7	Theory Exam-III (End term)	25
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous Evaluation)	10
15	Lab Evaluation-II (End term)	NIL
16	Course Portfolio (Coursera Course: Mastering bitumen for better roads and innovative applications)	10
	Total (100)	100

Retest scheme: Theory Exam-III 25

Course Syllabi (Theory):

1. Statistical Methods for Traffic Engineering: Elementary concepts of probability, mean, standard deviation and variance, Binomial, Poisson & Normal distribution, sampling theory and significance testing, Linear Regression and correlation.
2. Traffic Control Devices: Traffic signs-classifications & general specifications, Signals-advantages and warrants of traffic signals; design of signals, Road markings: objects & classification. Road Intersections: Classifications and importance; design of rotary intersection. Road safety audit.
3. Hot Mix Asphalt: Objectives of mix design, gradation and blending of aggregates, volumetric properties of compacted specimens, analysis of compacted asphalt mix, Various methods of mix design, Marshall method of mix design.
4. Types of bituminous mixes based on gradation: Dense graded; semi-dense graded; open graded and gap graded. Different types of bituminous mixes used in India as per MoRTH specifications. Sustainable highway construction materials such as Recycled Asphalt Pavements (RAP), plastic waste, steel slag, iron slag and copper slag as per IRC recommendations.
5. Asphalt pavement distresses: Identification, causes and treatments. Traffic and Environment: Detrimental effects of traffic noise, generation of noise by road traffic, techniques for control of traffic noise. Major air pollutants, air quality standards, measures for controlling air pollution.

Syllabus (Practical)

1. Proportioning of aggregates to achieve desired gradation for various mixes
2. Marshall method for design of bituminous mixes
3. Case study of road safety audit.
4. Design of rotary intersection
5. Case study of distress analysis of bituminous pavement
6. Case study to measure air and noise pollution at intersection

Text & references books:

- Bituminous Road Construction in India by Prithvi Singh Kandhal, PHI Learning Pvt. Ltd., 2016.
- Highway Engineering by S K Khanna, CEG Justo & Veeraragavan, Nem Chand Bros, Roorkee, 2014.
- Traffic Engineering & Transport Planning by L R Kadiyali, Khanna Publishers, New Delhi.
- Specifications for Road and Bridge Works, Ministry of Surface Transport & Highways, IRC, New Delhi (5^{th} revision)
- IRC codes

Online References:

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk?skipBrowseRedirect=true

Course Title and Code: CAD-BIM Specialisation: CE1401	
Hours per Week	**Curated MOOC (approx. 1 hr. per week)**
Credits	**4**
Students who can take	**B.Tech.**

Course Objective: This course aims to develop understanding about Autodesk Revit to build BIM models, clash detection, quantity takeoff, and 4D simulation. We will use Autodesk Revit and Navisworks to build our BIM models in this course.

Course Outcome:
On successful completion of this course, the students should be able to:

CE1401.1. Create 2D and 3D computer drawings and models of columns and stairs.
CE1401.2. Analyze and interpret different building component and assemble components as per material availability.
CE1401.3. Evaluate computer aided design models and assemblies.
CE1401.4. Apply key BIM standards.

Prerequisites: Basic knowledge of AutoCAD

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment (4 No.)	20 (MOOC:10)
3	Class Participation	Nil
4	Quiz(6No.)	25 (MOOC: 15)
5	Theory Exam I	Nil
6	Theory Exam-II	15
7	Theory Exam (End Term)	Nil
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	15
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation2	10
16	Course portfolio (MOOC)	15
	Total (100)	**100**

Retest

1	Theory Exam	15
2	Lab Evaluation	10

Course Contents:
3D CAD Fundamental: Welcome to CAD/BIM specialization, Magic Cube: familiar with [Line], [Divide], [Push/Pull], [Tape Measure] and [Guides], Curtain: familiar with [Scale], [Arcs], [Copy] and [Mirror] Solid Tool familiar with [Subtract], [Union], [Intersect] and [Split].
3D CAD Application: Basis of 3D modeling: Learn basic concept and start modeling, Building Structure: Create columns, walls, beams and slabs, Staircases: Create staircases and railings, Windows: Create detailed components, Modify and Place Component: Place components into building model, Model Assembling and Materials: Complete this building model.
BIM Fundamentals for Engineers: Fundamental BIM Knowledge, View & Retrieve Information from BIM Models, Modeling a BIM model.

Suggested Reading Materials:

BOOKS AND REFERENCES

- Building Information Modeling: BIM in Current and Future Practice, Publisher: John Wiley & Sons; 1 edition (15 August 2014), Language: English, ISBN-10: 9781118766309
- AutoCAD 2016 a Problem-Solving Approach 3D and Advance 22nd Edition
- Visualizing with CAD: An Auto CAD Exploration of Geometric and Architectural Forms
- Computer-aided Design/Engineering (CAD/CAE) Techniques and Their Applications: Advances in Theory by Cornelius T. Leondes
- Building Information Modeling by Kensek and Noble.
- "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors" by Charles M. Eastman, Rafael Sacks, Paul Teicholz, Kathleen Liston

This course would be delivered on coursera by Prof. Jessy kang National Taiwan University.

Course Name - Software Foundation & Programming
Course Code -IBM101
Credits – 4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

Syllabus (Theory)

Brief History of Computing Art and Science of Programming, Introduction to C Programming, Background of C, Getting Started with C, Constructs, Loops & Arrays, Functions, Pointers, User Defined Types, Binary I/O with Structures, Appendix. Reference Tables , Open Standards, Open Source, and IBM , What is an Open Standard , Open Standards Model , Industries needing standards , The Impact of Standards , Open Source Software , Open Source , Open Source Technology , The OPEN Proposition , Introduction to Linux , What is Linux , Background of Linux , Why is Linux so popular , What can you do with Linux , Linux Distributions, Linux Technology Center, Future of Linux, PHP, What is PHP, PHP – Key Driver of LAMP Stack, Getting Started with PHP, Unified ODBC, PHP Data Objects , PHP Deployment Platform, What is Zend Core, Features and Benefits, Zend and IBM, What is Ruby, What is Rails

Course Name - Software Foundation & Programming (With C++)
Course Code – CSESP201
Credits -- 4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

Syllabus (Theory)
Introduction to C++, OOPS, Essentials of Programming, Features of C++, Inheritance, Polymorphism & Encapsulation Operator Overloading, I/O in C++, Information Management, Information as a Service, IBM Information Management Software, Order Fulfillment System – Example Case, Open Source: Derby, Cloudscape, DB2 9 pureXML Technology, DB2 Express-C, DB2 Data Server Editions, Information Integration Business Drivers, Introduction to XML and Related Technologies, Issues in information exchange, What is XML?, Exercise: XML basics, Document type definitions (DTDs), Exercise: Working with DTDs, XML namespaces, Exercise: XML namespaces, XML schema, Exercise: Generating XML schemas, Introduction to Integrated Development Environment – Eclipse, What is Eclipse, Eclipse Architecture, Java Development Tools, The JDT environment, Debugging Applications, Eclipse Web Tools Platform Project 1.0.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CSE301	**Data Structures**	**3**	**1**	**2**	**0**	**5**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test–I	**Mid Term Test–II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test-I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks***
20	20	50	10	100	20	40	40	100

Syllabus (Theory)

UNIT I: Arrays as storage elements for representing polynomial of one or more degrees or addition & multiplication, sparse matrices for transposing & multiplication, stack, queue, dequeue, circular queue for insertion and deletion with condition for over and underflow, transposition of sparse matrices with algorithms of varying complexity (Includes algorithms for operations as mentioned).

UNIT II: Evaluation of Expression: Concept of precedence and associativity in expressions, difficulties in dealing with infix expressions, Resolving precedence of operators and association of operands, postfix & prefix expressions, conversion of expression from one form to other form using stack (with & without parenthesis), Evaluation of expression in infix, postfix & prefix forms using stack, Recursion.

UNIT III: Linear linked lists: singly, doubly and circularly connected linear linked lists insertion, deletion at/ from beginning and any point in ordered or unordered lists, Comparison of arrays and linked lists as data structures. Linked implementation of stack, queue and dequeue, Algorithms for/of insertion, deletion of stack, queue, and dequeue implemented using linked structures. Polynomial representation using linked lists for addition, Concepts of Head Node in linked lists. Searching, sequential and binary search.

UNIT IV: Non-Linear Structures: Trees definition, characteristics concept of child, sibling, parent child relationship etc., binary tree: different types of binary trees based on distribution of nodes, binary tree (threaded and unthreaded) as data structure, insertion, deletion and traversal of binary trees, constructing binary tree from traversal results, Threaded binary Tree, Time complexity of insertion, deletion and traversal in threaded and ordinary binary trees. AVL tree: Concept of balanced trees, balance factor in AVL trees, insertion into and deletion from AVL tree, balancing AVL tree after insertion and deletion, Application of trees for representation of sets.

UNIT V: Graphs: Definition, Relation between tree & graph, directed and undirected graph, representation of graphs using adjacency matrix and list, Depth first and breadth first traversal of graphs, finding connected components and spanning tree, Single source single destination shortest path algorithms. Sorting: Insertion, quick, Merge, heap, topological and bubble sorting algorithms for different characteristics of input data. Comparison of sorting algorithms in term of time complexity.

Syllabus (Practical)

1. To search an element in the array using Linear Search
2. To search an element in the 2-dimensional array using Linear Search.
3. To merge two sorted arrays into one sorted array.
4. To perform the following operation in Matrix
   1) Addition 2) Subtraction 3) Multiplication 4) Transpose
5. To perform following operation on strings using string functions
   1) Addition 2) Copying 3) Reverse 4) Length of String.
6. To search an element in the array using Iterative Binary Search. 8To search an element in the array using Recursive Binary Search.
7. To implement Stack using array.
8. To implement Queue using array.
9. To implement Bubble Sort & Selection Sort.
10. To implement Insertion Sort & Quick Sort.

11. To implement Merge sort.
12. Write a program to create a Linked List and perform operations such as insert, delete, update and reverse.

Text Book(s)

1. Thareja, R. (2015). Data structure using C (4thed.). New Delhi: Oxford University Press.
2. Kanetkar, Y. (2012). Data structures through C (6thed.). New Delhi: BPB Publications.
3. Langsam, Y., Augenstein, M. &Tenenbaum, A. M. (2015). Data structures using C and C++ (2nded.). New Delhi: Pearson.

Reference Book(s)

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hop croft, Data Structures and Algorithms. Pearson Education, 2012

2. Introduction to Algorithms, Corman T.H., Leiserson, C.E., and Rivest, R.L., MIT Press, 2013. (Indian reprint: Prentice-Hall).
3. Data Structures and Algorithm Analysis in C, Weiss, Mark A:, A. W Int,. ed.,2nd ed., 2010

Web Resource(s)

http://nptel.ac.in/courses/106102064/1

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
ECE310	**Digital Electronics**	**3**	**1**	**2**	**0**	**5**

Mid Term Test - I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

Syllabus (Theory):

Digital system and binary numbers: Signed binary numbers, binary codes, cyclic codes, error detecting and correcting codes, hamming codes.

Gate-level minimization: The K-map method up to five variables, don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc-Clusky method (Tabular method)

Combinational Logic: Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decimal adder, binary multiplier, magnitude comparator, decoders, encoders, multiplexers, demultiplexers.

Synchronous Sequential logic: Sequential circuits, storage elements: latches, flip flops, analysis of clocked sequential circuits, state reduction and assignments, design procedure.
Registers and counters: Shift registers, ripple counter, synchronous counter. Programmable logic arrays.
Introduction to Microprocessor, Intel 8086 Microprocessor: Architecture, Register Organization, Instruction Set of 8086, Memory and I/O addressing, Assembly language programming.

Text Books:

1. M. Morris Mano and M. D. Ciletti, "Digital Design", 4th Edition, Pearson Education
2. Microprocessors and its Applications 2nd Edition, A. Nagoor Kan. Mc Graw Higher Ed.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>CSE304</td><td>Application Development</td><td>3</td><td>1</td><td>2</td><td>0</td><td>4</td></tr>
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<table>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test–I</th><th>Mid Term Test–II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test-I</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>40</td><td>40</td><td>100</td></tr>
</table>

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others
**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: Basic principles involved in developing a web site, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design, Home Page Layout, Design Concept. Basics in Web Design, Brief History of Internet, World Wide Web, creation of web site, Web Standards, Audience requirement.

UNIT II: Introduction to HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags Introduction to elements of HTML - Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.

UNIT III: Introduction to Cascading Style Sheets, Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties), CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Color, Creating page Layout and Site Designs.

UNIT IV: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in Java. Objects and Classes: Basics of objects and classes in Java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File this reference.

UNIT V: Inheritance in Java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic Programming, Casting objects, Instance of operator, Abstract class, Interface in Java, Package in Java, UTIL package.Text and Binary I/O, Binary I/O classes, Object I/O, Random access files.

Syllabus (Practical)

Experiment 1 (HTML Page)

I. (a) Create a webpage with HTML describing your department. Use paragraph and list tags.
(b) Apply various colors to suitably distinguish key words. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.
(c) Create links on the words e.g. “Wi-Fi” and “LAN” to link them to Wikipedia pages.
(d) Insert an image and create a link such that clicking on image takes user to other page.
(e) Change the background color of the page. At the bottom create a link to take user to the top of the page.

Experiment 2 (Tables)

I. (a) Create a table to show your class timetable.
(b) Use tables to provide layout to your HTML page describing your university infrastructure.

(c) Use <span> and <div> tags to provide a layout to the above page instead of a table layout.
(d) Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks.
(e) Embed Audio and Video into your HTML web page.

Experiment 3 (CSS)

I. (a) Apply in-line CSS to change colors of certain text portion, bold, underline and italics certain words in your HTML web page. Also change background color of each paragraph using in-line CSS.
(b) Write all the above styling in CSS in different file (.css) and link it to your webpage such that changes made in CSS file are immediately reflected on the page. Group paragraphs into single class and add styling information to the class in CSS.
(c) Create a simple form to submit user input like his name, age, address and favorite subject, movie and singer.
(d) Add few form elements such as radio buttons, check boxes and password field. Add a submit button at last.

Experiment 4 (JavaScript)

I. (a) Create a form like the one in previous experiment. Put validation checks on values entered by the user using JavaScript (such as age should be a value between 1 and 150).
(b) Write a JavaScript program to display information box as soon as page loads.
(c) Write a JavaScript program to change background color after 5 seconds of page load.
(d) Write a JavaScript program to dynamically bold, italic and underline words and phrases based on user actions.
(e) Write a JavaScript program to display a hidden div (e.g. showing stats of a player when user clicks on his name).

Experiment 5 (CGI)

I. (a) Create a form using CGI-PERL paradigm, preferably as close to the one in experiment 3 as possible.
(b) Write CGI program to encode form and submit it.
(c) Write CGI program to decode the form you encoded previously and fetch the details submitted by user.
(d) Write CGI program to process the form details and show them back to the user.
(e) Using the concepts from above 4 steps, create a simple calculator.

Experiment 6 (Validator)

I. (a) Write a simple HTML code incorporating simple tags, list and div. Try validating it on validator.w3.org
(b) Add suitable header tags and format according to the validator. Validate it successfully.
(c) Add CSS file to style your document. Revalidate it using validator.
(d) Add links, images and tables. Revalidate it using validator.
(e) Add your own XML tags. Revalidate it using validator.

Textbook(s)

1. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Pearson, Ninth Edition, 2016.
2. Core Java Volume-I Fundamentals, Horstmann & Cornell, Pearson Education, Eight Edition, 2008
3. Beginning HTML, XHTML, CSS, and JavaScript, John Duckett, Wiley India, 2010

Reference Book(s)

1. The Complete Reference, Java 2, Herbert Schild, TMH, (Ninth Edition), 2014
2. Headfirst Java, Katy Sierra & Bert Bates, SPD (O'Reilly), Second Edition, 2005

Web Resource(s)

http://nptel.ac.in/courses/106106156/

Course Name - Object Oriented Programming Using JAVA
Course Code – CSESP301
Credits -- 4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

Syllabus (Theory)
Introduction to object-oriented programming , Object concepts , Key principles of object-oriented programming , Development project life cycle ,Introduction to UML: Static UML Diagrams – Class, Object, Component, Deployment, Dynamic UML Diagrams – Use Case, Sequence, Activity, State Chart, Introduction to the Java programming language , Introduction to the Java development and Productivity tools, Object-oriented programming ,Java syntax basics - Java syntax basics, Writing simple Java code using the IDE , Building classes, Debug applications, Inheritance , Design patterns and refactoring , Interfaces , Collections, Generics, Threads and synchronization , Utility classes , Exceptions and exception handling , I/O and serialization , JavaBeans , Introduction to Java EE Web Component , Overview of Servlets , Java EE Container Services Overview , Servlet API, Overview of JavaServer Pages, JavaServer Pages Specification and Syntax , Create and Edit HTML and JSPs , Debugging Web Applications , Web Archive Deployment Descriptor , Session State Storage Issues , Cookie API , HttpSession: Management of Application Data, URL Rewriting , Best Practices for Session Management , JSP Expression Language , JSP Custom Tags , JSP Tag Files , Create and Edit Servlets, Filters, and Listeners , XDoclet and Annotations , Connecting to a database , Web Application Security, Java EE Packaging and Deployment, Best Practices for Server-Side Application Development

<table>
<tr><th rowspan="2" colspan="2">Course code</th><th rowspan="2" colspan="4">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="2">CSE402</td><td colspan="4">Discrete Structures</td><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test–I</th><th>Mid Term Test–II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test-I</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td></td><td></td><td></td><td></td></tr>
</table>

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT I: Language of Logic: Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contrapositive, Bi-conditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Quantifiers, Arguments

UNIT II: Proof Methods: Vacuous, Trivial, Direct, Indirect by Contrapositive and Contradiction, Constructive & Non-constructive proof, Counterexample. The Division Algorithm, Divisibility Properties (Prime Numbers & Composite Numbers), Fundamental Theorem of Arithmetic, Principle of Mathematical Induction, The Second Principle of Mathematical Induction, Algorithm Correctness: Partial Correctness, Loop Invariant.

UNIT III: Graph Theory: Graphs – Directed, Undirected, Simple, Adjacency & Incidence, Degree of Vertex, Sub graph, Complete graph, Cycle & Wheel Graph, Bipartite & Complete Bipartite Graph, Weighed Graph, Union of Simple Graphs. Complete Graphs. Isomorphic Graphs, Path, Cycles & Circuits Euclerian & Hamiltonian Graphs. Planar Graph: Euler's Formula. Trees: Spanning trees- Kruskal's Algo, Prim's Algo. Finding Spanning Tree using Depth First Search, Breadth First Search, Complexity of Graph

UNIT IV: Sets and Functions: Sets: Definition and types, Set operations, Partition of set, Cardinality (Inclusion- Exclusion & Addition Principles), Recursive definition of set. Functions: Concept, Some Special Functions (Polynomial, Exponential & Logarithmic, Absolute Value, Floor & Ceiling, Mod & Div. Functions), Properties of Functions, Cardinality of Infinite Set, Countable & Uncountable Sets, the Pigeonhole & Generalized Pigeonhole Principles, Composition of Functions

UNIT V: Relations: Boolean Matrices, Binary Relation, Adjacency Matrix of Relation, Properties of Relations, Operations on Relations, The Connectivity Relations, Transitive Closure - Warshall's Algorithm, Equivalence relations- Congruence Relations, Equivalence Class, Number of Partitions of a Finite Set, Partial & Total Orderings

Text Book(s)

1. Kenneth Rosen, Discrete Mathematics and its applications, 5th edition, Tata-McGraw Hill, 2002.
2. C.L. Liu, Elements of Discrete mathematics, McGraw-Hill, 1985

Reference Book(s)

1. D. B. West, Introduction to Graph Theory, Prentice Hall of India,2001.
2. M. Artin, Algebra, Prentice-Hall India, 1991

Web Resource(s)

http://nptel.ac.in/courses/106106094/

Course Title and Code: Computer Architecture & Organization**:** CSE403	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech Sem IV (2017-2021)

Course Objective: In this course, students will be introduced to the basics of hardware components from basic gates to memory and I/O devices, instruction set architectures and assembly language to improve performance.

Learning Outcome:

On successful completion of this course, the students should be able to:

- Explain the instruction set of 8086 microprocessors, addressing modes, instruction execution cycle and interpretation of instructions.
- Summarize and compare the architecture of different computer systems.
- Analyze memory hierarchy and its impact on computer cost/performance.
- Develop assembly language programs using various data transfer instructions, addressing modes, status register and stack.
- Detect pipeline hazards and identify possible solutions to those hazards
- Design high-performance computer architecture using cache memory, virtual memory, pipelining, parallelism and RISC methodology.
- Evaluate performance and energy efficiency using Standard Performance Evaluation Corporation (SPEC) tools.
- Describe and compare various standard computer ports and buses such as USB, PS/2, ATA, IDE, SCSI, AGP etc. defined by Industry Standard Architecture (ISA), PCMCIA and IEEE.

Prerequisites		**Nil**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	10
03	Class Participation	Nil
04	Quiz	10
05	Theory Exam-I	10
06	Theory Exam-II	Nil
07	Theory Exam-III	25
08	Report-I (Case Study)	05
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	20
16	Course Portfolio	Nil
	Total (100)	100

Syllabus (Theory)

UNIT I: Basic structure of Computer Systems: Functional units, Basic operational concepts, Bus structures, Performance and metrics, Instructions and instruction sequencing, Hardware, Software Interface, Instruction set architecture, Addressing modes, RISC, CISC, ALU design, fixed point and floating-point operations.

UNIT II: Fundamental concepts, Execution of a complete instruction, Multiple bus organization, Hardwired control, Micro programmed control, Nano programming.

UNIT III: Pipelining: Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations, Exception handling.

UNIT IV: Memory systems: Basic concepts, Semiconductor RAM, ROM, Speed, Size and cost, Cache memories, Improving cache performance, Virtual memory, Memory management requirements, Associative memories, Secondary storage devices.

UNIT V: I/O organization: Accessing I/O devices, Programmed Input/Output, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB), I/O devices and processors, Comparison of various standard computer ports and buses such as USB, PS/2, ATA, IDE, SCSI, AGP etc. defined by Industry Standard Architecture (ISA), PCMCIA and IEEE

Reference Books:

1. Stallings, William. Computer organization and architecture: designing for performance. Pearson Education India, 2003.
2. Mano, Morris M. "Computer systems architecture." (2006).
3. Patterson, David A., and John L. Hennessy. Computer Organization and Design MIPS Edition: The Hardware/Software Interface. Newnes, 2013.
4. Hayes, John P., Trevor N. Mudge, Quentin F. Stout, Stephen Colley, and John Palmer. "Architecture of a Hypercube Supercomputer." In ICPP, pp. 653-660. 1986.

Course Title and Code: Database Management Systems: CSE401	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	Sem IV (2017-2021)

Course Objective: This course introduces the fundamental concepts of database systems and modelling of real-world problems using ER-model /UML and to convert ER model into relational model. This course helps students to work with Database management system to develop and manage database. This course helps students to implement SQL and to normalize a given database. It also includes transaction management and methods of concurrency control.

Learning Outcome:

On successful completion of this course, the students should be able to:

1. Outline database system components and their functions
2. Model the real-world systems from the given requirements specification using Entity Relationship Diagrams/Unified Modelling Language
3. Convert the ER model into a relational logical schema using various mapping algorithms
4. Apply SQL commands to define, query and manipulate a relational database.
5. Apply SQL coding standards to embed SQL in an application program.
6. For a given query, write relational algebra expressions and optimize the same.
7. Convert relational algebra expressions into SQL commands and vice versa.
8. Normalize a given database up to Boyce Codd Normal Form (BCNF) based on identified keys and functional dependencies
9. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
10. For a given transaction-processing system, determine the concept of deadlock in transaction and apply the method of deadlock avoidance and deadlock detection and recovery.
11. Apply various concurrency control protocol like two phase locking, timestamping and the method of log base recovery in case of failure.
12. Model the database project while keeping overall cost of development and maintenance low.

Prerequisites		**Nil**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	10
03	Class Participation	Nil
04	Quiz	10
05	Theory Exam (Mid Term)	15
06	Theory Exam	Nil
07	Theory Exam (Final)	30
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	10
12	Project -2	25
13	Project -3	Nil
14	Lab Evaluation I	Nil
15	Lab Evaluation II	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus (Theory)

UNIT I: Basic Concepts : data, database, database systems, database management systems, instance, schema, Database Applications, Purpose and Advantages of Database Management System (over file systems), View of Data (Data Abstraction, Data Models), Database Languages (DML, DDL), Relational Databases (Tables, DML, DDL), Data Storage and Querying (Components, Storage Manager, Query Processor), Database Architecture, Database User and Administrators

UNIT II: Design Phases, Design Alternatives (Major Pitfalls), Entity Relational Model (Entity Sets, Relationship Sets, Attributes), Constraints (Mapping Cardinalities, Keys, Participation Constraints), Entity Relationship Diagram, Weak Entity Set, Extended E-R features (Generalization, Specialization and Aggregation), E-R Notations, Examples of ERD

UNIT III: Features of Good Relational Design, Atomic Domain and First Normal Form, Decomposition Using Functional Dependency (Key and Functional Dependency, BCNF, 2NF, 3NF), Functional Decomposition Theory (Closure Set of Functional Dependency with Armstrong Rules, Canonical Cover and Loseless Decomposition), Dependency Preservation, Comparison of 3NF and BCNF, Decomposition Using Multi-Valued Dependencies (Multi-Valued Dependency and 4 NF)

UNIT IV: Structure of Relational Databases (Basic Structure, Database Schema, Types of Keys), Fundamental Relational Algebra Operations (Select, Project, Union, Set Difference, Cartesian Product and Rename Operator), Additional Relational Algebra Operators (Set Intersection, Natural Join, Division Operator, Assignment Operator), Examples

UNIT V: (Transaction State, Basic Definitions, ACID Property), Implementation of Atomicity and Durability (Shadow Paging Concept), Concurrent Execution (Reasons of Concurrent Execution, Serial and Concurrent Schedule), Serializability (Conflict and View Serializability), Recoverability of Schedules (Recoverable Schedule and Cascade-less Schedule), Lock-based Protocol (Types of Lock and Deadlock Concept), Two-Phase Locking Protocol, Deadlock Handling (Deadlock Prevention Techniques like Wait-Die, Wound-Wait), Recovery of Deadlock (Selection of victim, Rollback, and Starvation), Insert and Delete Operations (Delete, Insertion, Phantom Phenomenon), Transaction Failure, Storage Structure and Transaction Log and Log-Based Recovery (Deferred Database Modification, Immediate Database Modification, Checkpoints)

Syllabus (Practical)

Introduction to SQL, Advantages of using SQL, SQL concepts and tools, The generic SQL Sentence Construct, Create Table, Insertion of Data into tables, Viewing data in the tables, Delete Operations, Update Operations, Modifying the structure of tables, Renaming Tables, Destroying Tables, Examining Objects created by a User, Arithmetic Operators, Logical Operators, Range Searching, Pattern Matching, Column Alias, Aggregate Functions, Scalar Functions, Date Conversion Functions, Data Constraints, Defining integrity constraints in the alter table command, Dropping integrity constraints in the alter table command, Default Value Concept, Grouping Data from tables, Manipulating dates in SQL, Subqueries, Joins, Union, Intersect and Minus Clause, Index, View, Sequence

Reference Books:

1. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. Database system concepts. Vol. 4. New York: McGraw-Hill, 1997.
2. Date, Christopher John. An introduction to database systems. Pearson Education India, 2006.
3. Singh, Shio Kumar. Database systems: Concepts, design and applications. Pearson Education India, 2011.
4. Elmasri, Ramez, and Shamkant Navathe. Fundamentals of database systems. Addison-Wesley Publishing Company, 2010.
5. Coronel, Carlos, and Steven Morris. Database systems: design, implementation, & management. Cengage Learning, 2016.

Course Name - Information Management Basics
Course Code – CSESP401
Credits -- 4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

Syllabus (Theory)
Relational Databases - Installation and Planning, Data Modeling and Database Design, Relational Databases Introduction to RDBMS, Understanding a table, Relational Concepts, Database Query Languages Simple SQL Queries, Retrieving Data from Multiple, Scalar Functions and Grouping, Database Query Languages Column Functions and Grouping, Union, Using Sub-queries, Views and Results during DB Design, Integrity Rules, Indexes Logical Data Structures, Physical Implementation, Intermediate SQL, Maintaining Data, Creating and Accessing DB2, Databases, Planning Disk Usage, Data Migration Methods –Loading Tables, Capacity Management.

Course Title and Code Operating System**:** CS1108	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech Sem V

Course Objectives:

The main aim of this course is to develop an understanding of the fundamental concepts and techniques of operating systems.

Learning Outcome:
On successful completion of this course, the students will be able to:

1. Use basic LINUX commands: file/directory handling, standard I/O, redirection, pipes and filters.
2. Analyze the structure of OS and its interface with hardware.
3. Differentiate between different types of operating systems – Multiprogramming systems, Time-sharing systems, Parallel systems, Real-Time systems, Distributed systems and Mobiles systems. Compare Windows, Android and LINUX OS with respect to their key features and functionality.
4. Differentiate between various states of process and their representation using process control block (PCB). Analyze data structures used by an OS to manage the processes.
5. Implement and Assess the performance of different types of scheduling algorithms.
6. Examine process synchronization and Inter process communication- Race condition, semaphores, monitors, inter process communication through message passing.
7. Categorize the conditions that cause deadlock in resource allocation. Implement deadlock handling strategies.
8. Analyze paging, segmentation, and segmentation with paging for VM support in memory management. Implement different page replacement algorithms.
9. Analyze and implement various disk-scheduling algorithms.

Prerequisites: Computer Organization & Architecture

Sr. No	**Specifications**	**Marks**
01	Attendance	NIL
02	Assignment	NIL
03	Class Participation	NIL
04	Quiz	20
05	Theory Exam-I	NIL
06	Theory Exam-II	NIL
07	Theory Exam-III	30
08	Report-I	NIL
09	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	20
15	Lab Evaluation-II	30
16	Course Portfolio	NIL
	Total (100)	100

Evaluation Scheme for Retest		
1	Theory Exam-III	30
	Total	**30**

Syllabus (Theory)

UNIT-1: **Introduction to OS:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, services, system calls, characteristics of OS, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on LINUX and WINDOWS Operating System.

UNIT-2: Process: Concept of process, Process states, Process State transitions, Process Control Block (PCB), Context switching, **Thread:** Definition, Benefits of threads, Types of threads, multithreading. **Process scheduling**: Foundation and Scheduling objectives, Types of Schedulers. **Scheduling criteria:** CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time**. Scheduling algorithms:** Pre-emptive and Non pre-emptive, FCFS, SJF, Priority, R-R scheduling, Multilevel queue scheduling. **Inter process communication:** Critical section, Race condition, semaphores, monitors, message passing, Classical IPC Problems: Readers-Writer Problem, Dinning Philosopher Problem etc. **Deadlock:** Shared resources, resource allocation and scheduling, resource graph models, deadlock prevention, deadlock avoidance, deadlock detection, deadlock recovery algorithms.

UNIT-3: Memory Management: Memory management schemes, Contiguous/Non-contiguous memory allocation, storage management, paging, page table structure, segmentation, segmentation with paging, virtual memory, demand paging, page fault, Page replacement algorithms.

UNIT-4: File management: file concept, types and structures, attributes of a file, operations performed on file, File organization and access method, file allocation methods, directory structure, file directories, directory implementation.

UNIT-5: I/O Hardware: I/O devices, I/O hardware, device driver, Kernel I/O sub-system, Interrupt. **Disk scheduling:** Disk Structure, FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK.

Contents (Lab)

- Linux Operating System, components of Linux system.
- Basic LINUX commands and its Use.
    - Execution of various file/directory handling commands.
    - Commands related to standard I/O, Redirection, Pipes and Filters.
- Process Management Commands in Linux.
- Implementation of CPU Scheduling Algorithms.
- Implement Semaphores.
- Implement of Banker’s Algorithm for Deadlock Avoidance.
- Implement the page replacement algorithms.
- Implement disk scheduling algorithms.

Reference/Text Books:

- Silberschatz, Peter B. Galvin and G. Gagne, Operating System Concepts, Wiley, 2012.

- W. Stallings. Operating Systems: Internals and design Principles, Pearson Education, 2014.
- M. G. Venkateshmurthy. Introduction to Unix & Shell Programming, Pearson Education, 2009.
- Andrew S. Tanenbaum and Herbert Bos. Modern Operating Systems, Pearson Education, 2014.
- Thomas Anderson and Michael Dahlin. Operating Systems: Principles and Practice, Recursive Books, 2014.
- Richard Blum, Christine Bresnahan. Linux Command Line and Shell Scripting Bible, Wiley, 2015.
- Daniel P. Bovet, Marco Cesati. Understanding the Linux Kernel, O'Reilly media 3rd Edition, 2005.
- https://nptel.ac.in/courses/106/106/106106144/
- https://nptel.ac.in/courses/106/105/106105214/

Course Title and Code: Design & Analysis of Algorithms CS1105		
Course Description: This course introduces an understanding of the design and analysis of algorithm. The course demonstrates a familiarity with major algorithms and data structures and analyze the asymptotic performance of algorithms. It applies important algorithmic design paradigms and methods of analysis and synthesize efficient algorithms in common engineering design situations. **Learning Outcome** On successful completion of this course, the students should be able to: 1. Analyze the complexity of different algorithms using asymptotic analysis. 2. Analyze and select an appropriate data structure for a computing problem. 3. Differentiate between different algorithm designs technique: Divide and Conquer Technique, Greedy, Backtracking, and Dynamic Programming. Also explain when an algorithmic design situation calls for using these. 4. Develop algorithm and programs using Divide and Conquer technique to solve various computing problems, e.g., Sorting, Strassen's matrix multiplication, and Closest pair. 5. Develop energy efficient algorithms and programs using Greedy approach to solve various computing problems, e.g., Minimum Spanning Trees, Shortest Path, Knapsack, Job scheduling, Graph colouring etc. 6. Develop algorithms and programs using Backtracking technique to solve various computing problems, e.g., N queen, M-coloring, Hamiltonian Cycle detection, Travelling salesman, and Network flow. 7. Develop algorithms and programs using Dynamic Programming technique to solve various computing problems, e.g., Knapsack, Shortest path, Coinage, Matrix Chain Multiplication, Longest common subsequence. 8. Apply Query optimization algorithms using Greedy and Dynamic programming approaches. 9. Apply various search-based problem-solving methods e.g., Uninformed search (BFS, DFS, DFS with iterative deepening), Heuristics, and Informed search (hill-climbing, generic best-first, A*). 10. Evaluate and apply appropriate energy efficient algorithmic design technique for solving complex computing problem. 11. Explain the ways to analyze randomized algorithms (expected running time, probability of error). 12. Apply differentiation between P, NP, NP-Complete, and NP-Hard problems.		
Prerequisites		**Nil**
Hours per Week		**L-T-P: 3-0-2 (Out Class-4) (Weeks-12)**
Credits		**4**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	10
03	Class Participation	Nil
04	Quiz	10
05	Theory Exam (Mid Term)	15
06	Theory Exam	Nil
07	Theory Exam (Final)	30
08	Report-1	0
09	Report-2	0
10	Report-3	0
11	Project -1	0
12	Project -2	25
13	Project -3	Nil
14	Lab Evaluation (Final)	10
15	Course portfolio	00
	Total (100)	**100**

Syllabus (Theory)

UNIT I: Introduction: Algorithms, Analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Types of approaches,

UNIT II: Selection sort, Bubble sort, Insertion Sort, Shell sort, Quick sort, Merge sort, Heap sort, Sorting in linear time: Radix sort, Counting Sort, Comparison of sorting algorithms, Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching

UNIT III: Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms.

UNIT IV: Dynamic programming with examples such as Knapsack, All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem, Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, Hamiltonian Cycles and Sum of subsets.

UNIT V: Selected Topics: String Matching, Huffman Coding, Theory of NP-completeness, Approximation algorithms and Randomized algorithms.

Textbook(s)

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Prentice Hall of India.

Reference Book(s)

1. RCT Lee, SS Tseng, RC Chang and YT Tsai, "Introduction to the Design and Analysis of Algorithms", Mc Graw Hill, 2005.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Berman, Paul," Algorithms", Cengage Learning.
4. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
CS1109	**Theory of Computation and Compiler Design**	**3**	**0**	**2**	**0**	**4**

Syllabus (Theory)

Finite automata: Review of Automata, its types and regular expressions, Equivalence of NFA, DFA and €-NFA, Conversion of automata and regular expression, Applications of Finite Automata to lexical analysis.
Chomsky hierarchy of languages and recognizers, Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Context Sensitive features like type checking.
PDA and Parser: Push down automata, top down and bottom-up parsing, YACC programming specification
Turing Machine: Turing Machine as language acceptors and its design, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP).
Code generation and optimization: Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code generation, type conversions, and equivalence of type expression, Code generation and optimization.

Course Title and Code:	Cloud Computing CS1304	
Hours per Week	L-T-P: 3-0-2	
Credits	4	
Students who can take	B.Tech Sem V(IBM Cloud Computing)	

Course Objective- This course will prepare students to develop, build, deploy, and test applications using a cloud platform to build Software as a Service (SaaS) solutions. This will require cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services.

Learning Outcome(Provided by IBM):
On successful completion of this course, the students should be able to:
1. Understand the architecture of IBM Cloud
2. Understand how to manage your IBM Cloud account with IBM Cloud CLI and Cloud Foundry CLI
3. Deploy an application from Eclipse to IBM Cloud
4. Build and Deploy code to IBM Cloud using DevOps
5. Understand the characteristics of REST APIs and JSON data format
6. Describe the role of Node.js for server-side scripting

Prerequisites		-
Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	10
04	Quiz	10
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III (Certification Exam by IBM)	30
08	Report-I	Nil
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	20
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	100

Syllabus (Theory)

Module I - Cloud Application Foundations
- Understanding Cloud Computing technologies
- Introduction to HTML5 and JavaScript programming

Module II - Cloud Application Developer
- Cloud Service models (IaaS, PaaS, SaaS)
- Bluemix applications
- Building applications using Node.js, Eclipse, Cloud Foundry and

- DevOps Services
- REST architecture, JSON and Functional security
- Data Services in Bluemix
- Server side JavaScript
- Web Application framework

Reference Books:

1. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 2014.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 2015.
3. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 2016.

Course Title and Code:	Business Intelligence: CS1305		
Hours per Week	**L-T-P: 3-0-2**		
Credits	**4**		
Students who can take	B.Tech Sem V (IBM BDA Specialization)		
Course Objective- This course will prepare students to understand report building techniques using relational data models. They will also learn how to enhance, customize, and manage professional reports and will then further be explained about Active reports content and functionality.			
Learning Outcome (Provided by IBM): On successful completion of this course, the students should be able to: 1. Understand the importance of analytics and how it is transforming the world today 2. Understand how analytics provided a solution to industries using real case studies 3. Explain what analytics is, the various types of analytics, and how to apply it 4. Understand how a business analysis software works, and its architecture 5. Describe a reporting application, its interface, and the different report types 6. Create different types of advanced reports 7. Understand Active Reports and how to create them			
Prerequisites			-

Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	10
04	Quiz	05
05	Theory Exam-I	Nil
06	Theory Exam-II (Certification Exam by IBM)	25
07	Theory Exam-III	10
08	Report-I	Nil
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	30
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	**100**

Syllabus (Theory)

Business Analytics Overview: Analytics overview, Analytics trends: Past, present & future, Towards a predictive enterprise, Analytics: Industry domains, Case studies and solutions, Business Intelligence and Analytics 101, IBM Cognos Analytics for Consumers, Business analysis solutions

IBM Cognos Analytics: Author Reports Fundamentals – Introduction, Create list reports, Focus reports using filters, Create crosstab reports, Present data graphically, Focus reports using prompts, Extend reports using calculations, Use additional report building techniques, Customize reports with conditional formatting, Drill-through definitions, Enhance report layout

IBM Cognos Analytics: Author Reports Advanced – Introduction, create query models, Create reports based on query relationships, Create advanced dynamic reports, Design effective prompts, Create additional advanced reports, Examine the report specification, Distribute reports through bursting, Enhance user interaction with HTML,

IBM Cognos Analytics: Author Active Reports –Introduction to IBM Cognos Active Reports, Use Active Report connections, Active Report charts, visualizations, and decks

Reference Books:

1. Cindi Howson. *Successful Business Intelligence, Second Edition: Unlock the Value of BI & Big Data*. McGraw-Hill Education, 2013.
2. Dan Volitich, Gerard Ruppert. *IBM Cognos Business Intelligence 10: The Official Guide*. McGraw-Hill Education, 2013.

CS1111: **Computer Networks and Distributed Systems**

Course Objectives: This course aims to provide an understanding of the fundamental concepts of computer networking, layers of protocols and network technologies. It also includes the concept of Distributed System and associated algorithms to deal with Distributed system.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Categorize the various type of Networks based on geographical distance, topology and implementation.
2. Compare the function and services provided by different layers of OSI and TCP/IP network architectures.
3. Simulate the various Network topology in CISCO packet tracer.
4. Find out the errors in the transmitted segments through error correction and detection techniques like Checksum, Hamming Code, Cyclic Redundancy check etc.
5. Use various network monitoring commands like netstat, traceroute, ipconfig etc.
6. Analyze the underlying architectures and protocols of networking applications like File Transfers, Mail Transfers etc.
7. Apply the concepts of IP addressing, subnet masking and routing algorithms.
8. Apply and simulate different routing algorithms, e.g., DHCP, OSPF, BGP in packet tracer.
9. Apply and compare the sliding window – Transmission Control Protocols like Go-Back N, Stop-N-Wait and Selective Repeat using the criteria of segment loss, acknowledgement loss etc.
10. Analyze distributed systems and understand classification of agreement protocol.
11. Apply the concept of logical clocks and global clocks in distributed systems.

Teaching Scheme & Credits

Hrs. Per Week	Credits	Duration in Weeks
L P Out Class	04	12
3 2 4		

Evaluation Scheme

Course Title and Code Computer Network: CS1111			
Course Description			
Prerequisites		Nil	
Hours per Week		L-T-P: 3-0-2 /In Class-Out Class: 6-12	
Credits		4	
Sr. No	Specifications	Marks **(Pre-Covid)**	Post-Covid
01	Attendance	0	Nil
02	Assignment	10	20
03	Class Participation	0	Nil
04	Quiz	0	15
05	Theory Exam-1	15	15
06	Theory Exam-II	15	Nil
07	Theory Exam-III	30	20
08	Report-1	0	15
09	Report-2	0	Nil
10	Report-3	0	Nil

11	Project -1	15	Nil
12	Project -2	0	Nil
13	Project -3	Nil	Nil
14	Lab Evaluation1	15	15
15	Lab Evaluation2(Final)	0	Nil
16	Course portfolio	00	Nil
	Total (100)	100	

Evaluation Scheme for Retest	Theory Exam-III (30 marks)

Syllabus (Theory)

Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Physical Layer Transmission Media, Switching methods.

Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols - Overview of IEEE standards. Data Link Layer - Elementary Data Link Protocols, Sliding Window protocols, Error Handling.

Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control Internetworking - TCP / IP, IP packet, IP address, IPv6.Transport Layer: Transport Layer - Design issues, connection management,

Session Layer- Design issues, remote procedure call. Presentation Layer-Design issues, Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals etc.

Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection.

Agreement Protocols: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem

IEEE 802 Standards for Networks, RFC Standards, Energy Efficient routing algorithms, Energy efficient distributed systems.

Textbook(s)

1. Forouzan, B. & Fegan, S. C. (2011). Data communication and Networking (4^{th} ed.). New Delhi: McGraw HIll.
2. Tanenbaum, A. S. & Wetherall, D. J. (2014). Computer networks (5^{th}ed.). New Delhi: Pearson.
3. Stallings, W. (2014). Data and Computer Communications (9^{th}ed.). New Delhi: Pearson
4. Pradeep K. Sinha. Distributed Operating Systems. Concepts and Design.
5. Schaum's Outline of Theory and Problems of Computer Networking, McGraw Hill Education (India) Pvt. Ltd.

Course Title and Code:	Artificial Intelligence and Machine Learning; CS1110
Hours per Week	L-T-P: 3-0-2
Credits	4
Students who can take	B.TECH. CSE Sem V (2018-2022)

Course Objective:

This course introduces the fundamental concepts of artificial intelligence (AI) along with state-of-the machine learning (ML) algorithms. The course will cover the development of AI models to solve new as well as classical critical problems, and ML models to understand the real dataset to predict the future outcome. This course helps the students to pursue project related to AI and ML with real-world problems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
2. Implement intelligent agents for making computers solve critical problems the way human beings do.
3. Analyze the usage of Game theory and role of heuristics for building Intelligent Agents.
4. Apply AI techniques in applications which involve perception, reasoning and learning.
5. Acquire the knowledge of real-world knowledge representation.
6. Identify machine learning techniques suitable for a given problem.
7. Interpret fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
8. Use the standards and energy efficient ML algorithms.
9. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
10. Utilize state-of-the art algorithms of Machine Learning for building applications related to SDG goals

Prerequisites	Programming, Linear Algebra, Statistics

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	20
03	Class Participation	10
04	Quiz	Nil
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report-I	10
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	15
12	Project-II	15
13	Project-III	Nil
14	Lab Evaluation-I	Nil

15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	30
	Total	**30**

Syllabus:
UNIT–I: Introduction to Artificial Intelligence, History and Philosophy of AI, Intelligent Agents, Solving Problems by Searching, uninformed search, Informed Search and A*, Heuristics, Adversarial Search, Graph Pruning, Alpha-Beta Pruning, Min-Max Algorithm, Constraint Satisfaction Problems,
UNIT–II: First-Order Logic, Inference in First-Order Logic, Classical Planning, Planning and Acting in the Real World, Need of Representing and Reasoning Knowledge (Predicate, Prepositional and Fuzzy Logic)
UNIT–III: Introduction to Machine Learning, Supervised and Unsupervised Learning, Simple and Multiple Linear Regression, Decision Tree Regression, Fitting dataset and evaluating their performance set, Evaluation of selected features, Model evaluation metrics
UNIT–IV: K-Nearest Neighbor, Decision tree Classification Train/test split, Confusion matrix for evaluation, Class probabilities and class predictions, ROC Curve, Model evaluation metrics. Clustering; K-Means, Introduction to artificial neural network, kinds of neural network, perceptron algorithm
UNIT–V: Applications of Artificial Intelligence and Machine Learning; Usage of AI and ML Techniques for achieving sustainable practices, NIST and IEEE standards for AI and ML libraries, tools and techniques

Reference Books

1. Stuart Russell and Peter Norvig, “Artifcial Intelligence: A Modern Approach”, Third Edition, Pearson Education, 2010.
2. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2016

CS1114: Advanced Data Structures and Algorithms

<table>
<tr><td colspan="3">Course Title and Code
CS1114: Advanced Data Structures and Algorithms</td></tr>
<tr><td colspan="2">Hours per Week</td><td>L-T-P: 3-0-2</td></tr>
<tr><td colspan="2">Credits</td><td>4</td></tr>
<tr><td colspan="2">Students who can take</td><td>B.Tech. Odd Sem (VII)</td></tr>
<tr><td colspan="3">Course Objective-
The course aims to develop deeper understanding about algorithm design paradigms and advanced data structures for solving complex algorithmic problems.</td></tr>
<tr><td colspan="3">Learning Outcome:
On successful completion of this course, the students should be able to:
Argue the correctness of algorithms using inductive proofs and loop invariants.
Analyse algorithms using amortized analysis, including the accounting method and the potential method, as required.
Write program to solve algorithmic problems using divide-and-conquer paradigm.
Write program to solve algorithmic problems using dynamic-programming paradigm.
Implement variants of self-balancing tree.
Analyse, implement and use heap structures.
Analyse, implement and use hashing techniques.
Apply and implement the disjoint set data structures to solve problems modelled by graph.
Evaluate and apply appropriate energy efficient algorithmic design technique for solving complex algorithmic problem.</td></tr>
<tr><td colspan="2">Prerequisites</td><td>Nil</td></tr>
<tr><td>Sr. No</td><td>Specifications</td><td>Marks</td></tr>
<tr><td>01</td><td>Attendance</td><td>Nil</td></tr>
<tr><td>02</td><td>Assignments</td><td>20</td></tr>
<tr><td>03</td><td>Class Participation</td><td>Nil</td></tr>
<tr><td>04</td><td>Quiz (4)</td><td>20</td></tr>
<tr><td>05</td><td>Theory Exam</td><td>Nil</td></tr>
<tr><td>06</td><td>Theory Exam</td><td>10</td></tr>
<tr><td>07</td><td>Theory Exam (End-Term)</td><td>20</td></tr>
<tr><td>08</td><td>Report-1</td><td>Nil</td></tr>
<tr><td>09</td><td>Report-2</td><td>Nil</td></tr>
<tr><td>10</td><td>Report-3</td><td>Nil</td></tr>
<tr><td>11</td><td>Project-1</td><td>Nil</td></tr>
<tr><td>12</td><td>Project-2</td><td>Nil</td></tr>
<tr><td>13</td><td>Project-3</td><td>Nil</td></tr>
<tr><td>14</td><td>Lab Evaluation1</td><td>15</td></tr>
<tr><td>15</td><td>Lab Evaluation2 (End-Term)</td><td>15</td></tr>
<tr><td>16</td><td>Course portfolio</td><td>Nil</td></tr>
</table>

	Total (100)	**100**

Retest

1	Quiz	20
2	Theory Exam (End-Term)	20

Syllabus (Theory)

Unit 1: Amortized Analysis: Aggregate, Accounting and Potential Method, Dynamic tables, **External Sorting**: Introduction to external sorting. Selection trees & k-way merging. Run generation. Optimal merging of runs.

Unit 2: Binary Trees Variants: B Tree (2-3/2-3-4 Tree), RB Tree, Optimal Binary Search Tree, Splay tree, AA-Tree, Treap. **Indexed Tree**: T-tree, Queaps

Unit 3: String Matching Algorithms: Naïve, Rabin Carp, Knuth Morris Prat, and Boyer Moore. **String Processing Data Structures**: Rope, Tries, Suffix Tree, **Disjoint Set Data Structures:** Disjoint-set operations, representation of disjoint sets, Disjoint-set forests

Unit 4: Heaps: Binomial Heap, Fibonacci Heap, Pairing heap, Beap, Leftist tree, **Space partitioning tree**: Binary space partitioning, KD tree, Quad tree, Interval Tree, Segment Tree, Priority Search Tree.

Unit 5: Hashes: Introduction, Perfect hash function - Cuckoo hashing, Coalesced hashing, Universal Hashing. **Applications**: Searching, Memory Indexing, Computer Graphics, Image Data Structures, Computational Biology.

Syllabus (Practical)

1. Write a program in C to sort a small sequence using recursive merge sort algorithm.
2. Write a program in C to sort a small sequence using iterative merge sort algorithm.
3. Write a program in C to implement a K-way merge sort for external sorting of divide conquer and combine approach. Analyze and compare the complexity of it with any other sorting technique using asymptotic and amortized analysis.
4. Write a program in C to check if a binary tree is subtree of another binary tree.
5. Write a program in C to implement a BST with menu driven operations using array/linked list.
6. Write a program in C/C++ to implement a Splay tree for 20 user defined integers. Search for a specific key and display the preorder traversal on splay tree to see the search effect on self-balancing BST.
7. Write a program in C/C++ to implement Rope data structure most widely used for long string concatenation efficiently.
8. Write a program in C to search a pattern P in a text T using Boyer Moore pattern matching algorithm.
9. Write a program to implement a suffix tree for pattern matching, use the same pattern P and text T as in question 8.
10. Write a program in C++ to implement KD tree and search the minimum in tree. Compare the running time complexity with minimum search in BST of similar elements.
11. Use C++/Python STL to implement Hash/Map/Dictionary for optimal searching.

Text Books:

1. Samet, Hanan. Foundations of multidimensional and metric data structures. M. Kaufmann, 2006.
2. Mehlhorn, Kurt. "Sorting and Searching, volume 1 of Data Structures and Algorithms." (1984).

3. Mehta, Dinesh P., and Sartaj Sahni. Handbook of data structures and applications. Chapman and Hall/CRC, 2004.
4. Langsam, Yedidyah, Moshe Augenstein, and Aaron M. Tenenbaum. Data Structures using C and C++. Vol. 2. New Jersey: Prentice Hall, 2001.
5. Sartaj, Sahni. "Data Structures, Algorithms and Applications in C++." Computer Science, Singapore: McGraw-Hill (1998), reprint 2005.
6. Robert, L. Krune, Clovis L. Tondo, and Bruce P. Leung. "Data structures & Program Design in C." In O'Dougherty (production process staff workers) (second (hc) textbook ed.). Prentice-Hall, Inc. div. of Simon & Schuster, 2002.

Reference Books:
1. Allen, Weiss Mark. Data structures and algorithm analysis in C++. Pearson Education India, 2007.
2. Cormen, T. H., Charles E. Leiserson, R. L. Rivest, and C. Stein. "Introduction to algorithms 2nd edition. chpater 9: Medians and order statistics."
3. Hopcroft, John E., and Jeffrey D. Ullman. Data structures and algorithms. 1983 reprint 2001.
4. Standish, Thomas A. Data structures in Java. Addison-Wesley Longman Publishing Co., Inc., 1997. Reprint Pearson Education Asia (Addison Wesley), New Delhi, 2000
5. Knuth, Donald E. "The art of computer programming. Vol. 1: Fundamental algorithms." Atmospheric Chemistry & Physics (1978).
6. Heileman, Gregory L. "Data Structures, Algorithms, and Object-Oriented Programming. 1996.", Tata Mc-Graw Hill, 2002
7. Tremblay, Jean-Paul, and Paul G. Sorenson. "An introduction to data structures with applications." McGraw-Hill Computer Science Series, New York: McGraw-Hill, 1976 (1976).

Course Title and Code Software Engineering**:** CS1113	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech Sem VII

Course Objective: In this course, students will gain a broad understanding of the discipline of software engineering and apply theories, models, and techniques to solve real-world problems.

Learning Outcome:
On successful completion of this course, the students will be able to:

1. Use software development lifecycle models for project development.
2. Explain the advantages of agile software development over traditional software engineering methods.
3. Apply agile development method namely Extreme Programming (XP), Adaptive software development (ASD), Scrum and Crystal for software development.
4. Design solutions in various application domains using software engineering approaches that integrate ethical and economic concerns.
5. Elicit and Evaluate functional and non-functional requirements for a software system.
6. Design, represent and document software requirements specification according to IEEE standards.
7. Apply UML modelling for software design.
8. Apply coding standards and guidelines.
9. Prepare code checklist and perform code inspections, code reviews and walkthrough.
10. Develop and implement various manual and automated testing procedures.
11. Estimate the cost of software project.
12. Evaluate software in terms of software quality and quality assurance according to ISO standards.
13. Execute activities for software project such as re-engineering, reverse engineering and software configuration.

Prerequisites: : C, C++ or Java programming

Sr. No	**Specifications**	**Marks**
01	Attendance	NIL
02	Assignment	NIL
03	Class Participation	NIL
04	Quiz	20
05	Theory Exam-I	NIL
06	Theory Exam-II	NIL
07	Theory Exam-III	20
08	Report	10
09	Report-II	NIL
10	Report-III	NIL
11	Project	25
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL

16	Course Portfolio (MOOC certification)	25
	Total (100)	100
Evaluation Scheme for Retest		
1	Theory Exam-III	20
2	Quiz	20
	Total	**40**

Syllabus (Theory)

UNIT I: Basics, Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Software Development Life Cycle (SDLC) Models: Waterfall Model, Iterative waterfall model, Incremental Process Model, Evolutionary Development Models, Specialized Process Model, V-Model, An Agile view of process, Agile process models namely Extreme Programming (XP), Adaptive software development (ASD), Scrum and Crystal.

UNIT II: Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

UNIT III: Basic Concept of Software Design, Architectural Design, Low Level Design, Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design methods and Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design.

UNIT IV: Coding and Software Testing: Coding standards, programming style, code inspection, code review and walkthrough; Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-down and Bottom-up, Testing Strategies, Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products.

UNIT V: Software Measures, Metrics and Models: Various Size Oriented Measures, Hallstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures, Control Flow Graphs, Software metrics classification, Cost estimation models, Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO); Software quality and quality assurance, ISO standards; Software Re-engineering, Reverse engineering and Software Configuration.

Reference/Text Books:

- Pressman, Roger S. *Software engineering- A practitioner's approach*. McGraw Hill Education, 2014.
- Sommerville, Ian. *Software engineering*. Pearson education, 2015.
- Jawdekar, Waman S. Software Engineering: Principles and Practice. McGraw Hill Education 2004.
- Martin, Robert C. *Agile software development, principles, patterns, and practices*. Pearson, 2013.

S.No	Link	Name	Hours
1	https://www.coursera.org/learn/software-processes	Software Development Processes and Methodologies	15
2	https://www.coursera.org/learn/agile-software-development	Agile Software Development	12
Total Hrs.			27

Course Title and Code: Cyber Security: Identity and Access Management: CS1311	
Hours per Week	L-T-P: 3-0-2
Credits	4
Students who can take	B. Tech Sem VII (2017-2021) (CSE IBM-IS)

Course Objective: The course is aimed to prepare students with the skills required to identify, analyze and remediate computer security breaches. This course includes topics like cybersecurity, including network security, cloud security, system security, network infrastructure, protocols, and encryption. This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.

Learning Outcome:

On successful completion of this course, the students should be able to:

- Analyze and evaluate cyber security needs of an organization.
- Design and develop a security architecture for an organization.
- Design operational and strategic cyber security strategies and policies.
- Explore how cyber criminals are using operating system tools to get control.
- Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation and measure the performance and troubleshoot cyber security systems.
- Apply tools used by penetration testers and ethical hackers (network CLI tools, Telnet, SSH, Nmap, Wireshark, and many others).
- Implement cyber security solutions using cyber security, information assurance, and cyber/computer forensics software/tools.
- Manage high-end security enterprise solutions such as: IBM QRadar SIEM, Vulnerability Manager, UBA, IBM QRadar Advisor with Watson, I2 Analyst Notebook and IBM Cloud X-Force Exchange.
- Apply critical threat modeling methodologies and frameworks such as MITRE, Diamond, IBM IRIS, IBM Threat Hunting, and security intelligence approaches to threat management.
- Participate in Security Operation Center (SOC) role-playing scenarios: experiencing research insights through design thinking practices.
- Experience the basis for SOC—enacting the roles of triage analysts, incident response analysts, and threat intelligence analysts.

Prerequisites		Security Intelligence
Evaluation Scheme		
Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20 (COURSERA 10)
3	Class Participation	Nil
4	Quiz	20 TCS ION LX
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil

7	Theory Exam-III (IBM Certification Exam)	25
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	15
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	100
Evaluation Scheme for Retest		
1	Theory Exam-III	25
2	Lab Evaluation-II	10
	Total	35

Syllabus (Theory)

UNIT I – CYBERSECURITY LANDSCAPE

Cybersecurity in the World Today, Cyber Threats Taxonomy, Cybersecurity Domains CYBER RESILIENCE FRAMEWORK & LIFECYCLE: Cybersecurity Industry Challenges, Cyber Resilience Frameworks, Cyber Resilience Lifecycle

IDENTIFY CYBER ATTACK: Threat Landscape, Anatomy of a Cyber Attack, Threat Hunting Methodology

SOC IN ACTION: Security Operation Centers (SOC) Overview, SOC Operations Team, SOC Incident Lifecycle

UNIT II – NETWORK SECURITY

Network Security Landscape, Enterprise Network Security, Anatomy of a Network Attack

MOBILE & IOT SECURITY: Mobile & IoT Global Trends, Mobile & IoT Security Landscape, End-point Protection

APPLICATION SECURITY: Introduction to Web Applications, Application Security Practices, Application Security Attacks

UNIT III – DATA SECURITY

Data Breaches – Industry Overview, Insider Threat and Phishing Attacks, Ransomware and Fraud Attacks, Industry Case Study

CLOUD SECURITY: Cloud Global Trends, Cloud Security Challenges, Cloud Security in Practice, Industry Case Studies

SECURITY INTELLIGENCE: SIEM Landscape, SIEM Characteristics, SIEM in Action, SIEM Explained, SIEM Identifies a Phishing Attempt, Using the SIEM

Syllabus (Lab)

MONITORING GLOBAL SECURITY: Explore interactive security threats, Monitor global attacks in real-time

NETWORK SECURITY TOOLS: Understand the data behind your IP, explore your Command Line Interface, learn about basic tools attackers use, Cement industry best practices such as DNS

ENDPOINT SECURITY PRACTICES: Foot printing and how to find vulnerabilities, witness how an attacker takes control, protect yourself using Secure Shells, discover how X-Force keeps tabs online

WEB BANKING DATA BREACH SCENARIO: Understand role of a penetration tester, discover more methods to attack a system, Conceptualize repercussions of attacks
SCAN AND INVESTIGATE VULNERABILITIES: Create and run a patch scan, adjust impact scores for important assets, run a custom scan with active tests, Investigate a vulnerability
USING IBM QRADAR: Navigate the web interface, investigate suspicious activity, create a report, Manage network hierarchy
INVESTIGATING USER BEHAVIOR: Validate environment, run log events to generate user traffic, configure rules, Modify User Behavior Analytics, Investigate users
ANALYZING THREATS WITH INTEL: Prepare data in QRadar, trigger an offense and import into i2, Use ANB to perform investigation, import data into i2 Analyst's Notebook, examine human resource data.

Textbooks:

- T1. Li, Qing, and Gregory Clark. Security Intelligence: A Practitioner's Guide to Solving Enterprise Security Challenges. John Wiley & Sons, 2015.
- William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education.
- Kamath Nandan, "Law Relating to Computers Internet & E-commerce (A Guide to Cyber laws & the Information Technology Act, Rules, Regulations and Notifications along with Latest Case Laws)", 2012, Universal Law Publishing, 2016
- Hsu, D. Frank, and Dorothy Marinucci, eds. Advances in cyber security: technology, operations, and experiences. Oxford University Press, 2012.
- Geers, Kenneth. Strategic cyber security. Kenneth Geers, 2011.

Reference Books:

1. Johnson, Loch K. National security intelligence. John Wiley & Sons, 2017.
2. Roberts, Scott J., and Rebekah Brown. Intelligence-Driven Incident Response: Outwitting the Adversary. " O'Reilly Media, Inc.", 2017.
3. S.K. Verma and Raman Mittal, "Legal Dimensions of Cyber Space", Universal Law Publishing, 2004.

Course Title and Code:	Big Data Engineering; CS1312
Hours per Week	L-T-P: 3-0-2
Credits	4
Students who can take	B.Tech Sem VII (IBM BDA & CC Specialization)

Course Objective- The main goal of this course is to help students learn, understand, and practice modern big data technologies for scaling up data science techniques focusing on industry applications.

Learning Outcomes (Provided by IBM):

On successful completion of this course, the students should be able to:

1. Identify the characteristics of datasets and compare the trivial data and big data for various applications.
2. Select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
3. Integrate Data Science libraries in Python with big data technologies.
4. Use different SciKit package ML Algorithms.
5. Implement different IBM Watson Services like Notebook or Spark Services.

Prerequisites	Linux, SQL

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	Nil
04	Quiz	10
05	Theory Exam-I	Nil
06	Theory Exam-II	15
07	Theory Exam-III (Certification Exam by IBM)	25
08	Report-I	20
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	15
15	Lab Evaluation-II	15
16	Course Portfolio	Nil
	Total (100)	**100**

Evaluation Scheme for Retest

01	Theory Exam-II	15
02	Theory Exam-III	25
	Total	**40**

Syllabus (Theory) (Provided by IBM):

UNIT 1: Introduction to Big Data and Hadoop: What is Big data, 4Vs of Big Data, types of Big Data, the industry sectors that are using Big Data and it's Use Cases; Hadoop overview: Hadoop Introduction, Hadoop architecture, HDFS Introduction, HDFS architecture, MapReduce v 1.0 and YARN differences and their architecture

UNIT 2: Introduction to HDP: What is HDP, HDP Components, Big data and Spark, Resilient Distributed Datasets, Spark's Scala and Python shells, Programming with Spark, Spark SQL; Hive, Hive architecture, SQL for Hadoop, Hive and HBase, Pig, Characteristics of the Pig language, Sqoop, Sqoop commands

UNIT 3: Hadoop Security, Data Science and Data Governance: How is security provided in Hadoop. Data Governance, The need for data governance, Data Science - using the Scientific Method; AI >> Machine Learning >> Deep Learning, The Work of the Data Scientist, The art of Data Science in 5 steps

UNIT 4: Data Science Libraries: Getting started with Jupyter Notebook, How notebooks help data scientists; Essential packages: NumPy, SciPy, Pandas, Scikit-learn, Data visualizations: matplotlib, Data and notebooks in Jupyter

UNIT 5: BigSQL and IBM Watson Introduction: Big SQL integrates with RDBMS, Big SQL architecture, the relationship between Big SQL and Db2, Creating a Big SQL table; Introduction to IBM Watson Studio, Analyzing data with Watson Studio Reference

List of Experiments:

1. Familiarization with Hadoop Cluster.
2. Run Cloudera Compiled machine version
3. Run each and every basic command on hadoop/hdfs
4. Interact with Hadoop localhost System with memory Management.
5. Run Word count Program on Mapreduce.
6. Use Sqoop to manage the structured datasets.
7. Run Hive Commands to create Dynamic and Static partition.
8. Run different type of operations on datasets by using Data Science Library in python.
9. Program to Visualize the dataset by using different graphs.
10. Run Spark and Scala Service of IBM Watson.
11. Use IBM Watson for Data Visualization.

Text Material & Resources: IBM AP Skills Academy

Reference Books:

1. Benjamin Bengfort and Jenny Kim. *Data Analytics with Hadoop: An Introduction for Data Scientists*. O'Reilly Media, 2016.
2. Jake Vander Plas. *Python Data Science Handbook: Essential Tools for Working with Data*. O'Reilly Media, 2016.
3. James D. Miller. *Learning IBM Watson Analytics*. Packt Publishing Limited, 2016.

CS1308: Security Intelligence
(In collaboration with IBM)

Course Title and Code Security Intelligence**:** CS1308	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech Sem VI(2017-2021) (CSE IBM-IS)

Course Objectives: This course aims to provide comprehensive study of the principles and practices of computer system security including operating system security, network security, software security and web security. This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.

Course Description: Topics include common attacking techniques such as virus, Trojan, worms and memory exploits; the formalisms of information security such as the access control and information flow theory; the basic cryptography, RSA, DES, AES, Diffie Hellman key Exchange, cryptographic hash function, and password system; this course introduces students the principles of network and operating system security through hands-on exploration. Students will learn how to harden an operating system as well as secure the network by implementing technologies such as firewalls, Virtual Private Networks (VPN), and Intrusion Detection Systems (IDS).
This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Identify enterprise business and IT drivers that influence the overall IT Security Architecture
2. Define the role of a centralized Security Intelligence solution and how it integrates with other IT enterprise security components
3. Write an extensive analysis report on any existing security product or code, investigate the strong and weak points of the product or code
4. Develop SSL or Firewall based solutions against security threats, employ access control techniques to the existing computer platforms such as Unix and Windows NT
5. Explain how a Security Intelligence solution can be used to investigate and stop advanced threats and address IT governance and regulatory compliance
6. Describe how QRadar SIEM collects data to detect suspicious activities
7. Navigate and customize the QRadar SIEM dashboard
8. Investigate suspected attacks and policy breaches
9. Search, filter, group, and analyze security data
10. Investigate the vulnerabilities and services of assets
11. Locate custom rules and inspect actions and responses of rules
12. Use QRadar SIEM to create customized reports
13. Use charts and apply advanced filters to examine specific activities in your environment.

Prerequisites	**Basics of Computer Networks**

Evaluation Scheme			
Sr. No	**Specifications**	**Marks (Old Scheme)**	**Marks (Post-Covid)**
1	Attendance	Nil	Nil
2	Assignment	Nil	20
3	Class Participation	**10**	Nil
4	Quiz	**10**	15
5	Theory Exam-I	Nil	Nil

6	Theory Exam-II	**20**	Nil
7	Theory Exam-III (IBM Certification Exam)	**25**	25*
8	Report-I	Nil	Nil
9	Report-II	Nil	Nil
10	Report-III	Nil	Nil
11	Project-I	**15**	20
12	Project-II	Nil	Nil
13	Project-III	Nil	Nil
14	Lab Evaluation-I	**10**	10
15	Lab Evaluation-II	**10**	10
16	Course Portfolio	Nil	Nil
	Total (100)	**100**	100
Evaluation Scheme for Retest			
1	Theory Exam-III	25	25
2	Lab Evaluation-II	10	10
	Total	**35**	**35**

Syllabus (Theory)

Module I – Cyber Security Overview

Status quo of IT security, security Intelligence and operations, Attacks & Security, Threat, Vulnerability, Cryptography, Classical encryption techniques substitution, Ciphers and transposition ciphers, Cryptanalysis, Steganography

Module II – Information Security Algorithms

Data encryption standard (DES), Advanced Encryption Standard (AES), RSA algorithm, Message Authentication Codes, Digital Signature, Diffie Hellman Key Exchange, SSL, SET, PKI, PGP, S/MIME, Viruses, Malwares, IDS, Firewalls

Module II – Security Intelligence Foundations

Designing a Security Intelligence solution, Security Intelligence functional components

Module III – Security Intelligence Engineer

Collecting and processing events, flows, and vulnerability data, investigating an offense that is triggered by events, Investigating the events of an offense, using asset profiles to investigate offenses, investigating an offense that is triggered by flows, false positives overview, investigating superflows, using rules and building blocks, creating SIEM reports, performing advanced filtering

Textbooks:

1. T1. Li, Qing, and Gregory Clark. Security Intelligence: A Practitioner's Guide to Solving Enterprise Security Challenges. John Wiley & Sons, 2015.
2. William Stallings, “Cryptography and Network Security: Principals and Practice”, Pearson Education.
3. Behrouz A. Forouzan: Cryptography and Network Security, TMH
4. Hsu, D. Frank, and Dorothy Marinucci, eds. Advances in cyber security: technology, operations, and experiences. Oxford University Press, 2012.
5. Geers, Kenneth. Strategic cyber security. Kenneth Geers, 2011.

Reference Books:

1. Johnson, Loch K. National security intelligence. John Wiley & Sons, 2017.

2. Roberts, Scott J., and Rebekah Brown. Intelligence-Driven Incident Response: Outwitting the Adversary. " O'Reilly Media, Inc.", 2017.

Course Title and Code: Predictive Analytics Modeler (IBM Course) CS1309			
Hours per Week	**L-T-P: 3-0-2**		
Credits	**4**		
Students who can take	B.TECH. CSE (IBM BDA) Sem VI (2017-2021)		

Course Objective- This course will introduce to some popular predictive modeling techniques. This course will form a solid foundation of predictive analytics, which refers to tools and techniques for building statistical or machine learning models to make predictions based on data using IBM SPSS Modeler. This course will lead to exploratory data analysis to gain insights and prepare data for predictive modeling, an essential skill valued in the business.

Learning Outcomes (Provided by IBM):

On successful completion of this course, the students should be able to:

1. Understand the importance of analytics and how it's transforming the world today.
2. Understand how analytics provided a solution to industries using real case studies
3. Explain what analytics is, the various types of analytics, and how to apply it
4. Improve efficiency, sample records, and work with sequence data
5. Explain data transformations, and functions
6. Understand modeling, relationships, derive and reclassify fields
7. Integrate and collect data
8. Understand the principles of data mining
9. Use the user interface of modeler to create basic program streams
10. Read a statistics data file into modeler and define data characteristics
11. Review and explore data to look at data distributions and to identify data problems, including missing values
12. Use the automated data prep node to further prepare data for modelling

User a partition node to create training and testing data subsets

Prerequisites		Business Intelligence	
Sr. No	**Specifications**	**Marks (Pre-covid)**	**Marks (Post-covid)**
01	Attendance	Nil	Nil
02	Assignment	Nil	Nil
03	Class Participation	10	Nil
04	Quiz	Nil	10
05	Theory Exam-I	Nil	Nil
06	Theory Exam-II	15	Nil
07	Theory Exam-III (Certification Exam by IBM)	25	25*
08	Report-I	Nil	Nil
09	Report-II	Nil	Nil
10	Report-III	Nil	Nil
11	Project-I	20	35
12	Project-II	Nil	Nil
13	Project-III	Nil	Nil
14	Lab Evaluation-I	15	15
15	Lab Evaluation-II	15	15
16	Course Portfolio	Nil	Nil
	Total (100)	**100**	**100**
Evaluation Scheme for Retest			
1	Theory Exam-III	25	25
2	Lab Evaluation-II	15	15
	Total	**40**	**40**

Syllabus (Theory)

Business Analytics Overview, Trends, Case Studies, Understanding Business Intelligence and Analytics, Introduction to Data Mining CRISP-DM, Nodes and streams, Initial data mining, storage and field measurement, Understanding the data (valid and invalid values),Integrating data (methods, options, merging, and sampling) Deriving and reclassifying fields (CLEM), Looking for relationships (matrix, distribution, means, histogram, statistics and plot), Functions (conversion, string, and statistical), Data transformation, Statistical, graphical and sample nodes, Automated data mining and modelling, Predictive models and customer segmentation.
Case Studies on techniques of predictive analytics: Regression, Instance-based, Regularization, Decision Tree, Bayesian, Clustering, Deep Learning, Dimensionality Reduction, and Ensemble techniques

Reference Books:

1. McCormick, Keith, Dean Abbott, Meta S. Brown, Tom Khabaza, and Scott R. Mutchler. IBM SPSS modeler cookbook. Packt Publishing, 2013.
2. Morelli, Theresa, Colin Shearer, and Axel Buecker. "IBM SPSS predictive analytics: Optimizing decisions at the point of impact." IBM redpaper 4710 (2010).

Course Name: Enterprise Programming using JAVA
Course Code: CSE428 L-T-P: 1-0-2
Credits: 3

Course Description: The course focus on Java application programming interfaces (APIs), focusing on the APIs most commonly used in real-world Java applications such as Collections, Input/output (I/O), and Threads. The main concepts are overview of exception handling and Multithreading, JDBC API, web applications using Servlet, JSP, Aspect Oriented Programming using Spring Framework. This course also covers basic concepts for software design and reuse.

Learning Outcome:

On successful completion of this course, the students should be able to:

1. Design develop and debug software applications in Core Java taking into account coding and documentation standards.
2. Apply concepts like multithreading, interfaces, generics in Java program design and implementation.
3. Use JDBC API for database-independent connectivity between the Java programs and MySQL database.
4. Develop server-side solution using Servlet and JSP technologies.
5. Design, develop, and debug web applications using Aspect Oriented Programming using Spring Framework.

Enterprise Programming Using Java

Unit 1 – Object Oriented Programming Concepts-Java, JRE, JVM & JDK, Operators, Methods, Keywords, Control Structures, Method Overloading & Overriding, Input using Command Line Arguments & Scanner, Constructors, Finalizer(), Garbage Collection, Strings, Access Modifiers, Inner Classes, Cloning Objects, Abstract Classes, Interfaces, Packages, UTIL Package, File I/O using java.io package

Unit 2 - Exception Handling: The Idea behind Exception, Exceptions & Errors, Types of Exceptions, Control Flow in Exceptions, Multi-Threaded Programming, Thread Lifecycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads, Multithreading in JAVA.

Unit 3 – JDBC Programming **-** The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, Updating Database Data, Error Checking and the SQLException Class, The SQLWarning Class, The Statement Interface, PreparedStatement, CallableStatement The ResultSet Interface, Updatable Result Sets, JDBC Types, Executing SQL Queries, ResultSetMetaData, Executing SQL Updates, Transaction Management. Servlet API & Overview **-** Servlet Model: Overview of Servlet, Servlet Life Cycle, HTTP Methods Structure & Deployment descriptor ServletContext & ServletConfig interface, Attributes in Servlet, Request Dispatcher interface The Filter API: Filter, Filter Chain, Filter Config Cookies and Session Management: Understanding state and session, Understanding Session Timeout and Session Tracking, URL Rewriting

Unit 4 –Java Server Pages (JSP) **-** JSP Overview: The Problem with Servlets, Life Cycle of JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, JSP Directives, JSP Action, JSP Implicit Objects JSP Form Processing, JSP Session and Cookies Handling, JSP Session Tracking JSP Database Access, JSP Standard Tag Libraries, JSP Custom Tag, JSP Expression Language, JSP Exception Handling, JSP XML Processing.

Unit 5 – Java Web Frameworks: Spring MVC Overview of Spring, Spring Architecture, bean life cycle, XML Configuration on Spring, Aspect Oriented Programming **-** Spring, Managing Database, Managing Transaction.

NOTE: Integrated Development Environments (IDEs) to be used in this Course are Eclipse or NetBeans – Both are compatible for Enterprise Programming using Java.

Prerequisites		OOP
Teaching Scheme (Hours per Week)		L T P 1 0 2
Credits		3
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	
6	Theory Exam-II	20
7	Theory Exam-III	20
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	20
13	Project-III	
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	
	Total (100)	100
Evaluation Scheme for Retest		
	Theory Exam-III	20
	Lab Evaluation-II	10
	Total	30

References

1. Liang, Y. Daniel. Introduction to Java programming: comprehensive version. Pearson Education, 2018.
2. Zambon, Giulio. Beginning JSP, JSF and Tomcat: Java web development. Apress, 2012.

CSE429: Computing with SAS

Course Description: The aim is to introduce fundamental SAS programming language for use in database handling and preparation for analyses. Further, the aim is to introduce the student on how to use statistical procedures in SAS, with focus on descriptive statistics.

Learning Outcome

After course completion, the student will be able to

1. Describe statistical terms and symbols as per ISO standard ISO-3534.
2. Import/export, clean/process and transform data (e.g. Air quality dataset, Crime against woman dataset, Solar energy Dataset etc.) using SAS functions and programming statements.
3. Perform descriptive statistics using SAS procedures.
4. Write and debug the scripts, macros and programs with SAS system.
5. Analyze and interpret given data statistically as per ISO standard (ISO 5479, ISO 11453, and ISO 16269).
6. Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
7. Apply computing theory and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
8. Interpret data findings to any audience, orally, visually and in written formats.

Teaching Scheme and Credits

Hrs. per Week		Credits	Duration in Weeks
In Class	Out Class	03	12
05	10		

Evaluation Scheme

Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	20
03	Class Participation	10
04	Quiz	20
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam	Nil
08	Report-1	05
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	25
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	20
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Data Structures: Introduction to SAS interface and library structure and definition, reading data using Datalines and importing and exporting datasets, Infiles statement - reading raw data, Formats and Informats, Variable attributes and data modification using Data and Set statements

Data Management: Using conditional statements to modify data - Where, If and Nested If, Appending and

Merging datasets, SAS Functions for data manipulation, Loops and Arrays in SAS,
Report Generation: Basic Proc steps - like Proc Contents, Proc Format, Proc Report and Proc Tabulate, Proc steps for basic statistics - like Proc Univariate and Proc Means
Proc SQL: Introduction to SQL - basic DBMS and RDBMS concepts, Using SQL Procedures in SAS, Using conditional statements in SQL and aggregate functions, Data manipulation using Proc SQL
SAS Macros: Introduction to Macros, Local and Global declarations, Using built-in macro procedures and functions

Reference Books

1. Delwiche L. D. and Slaughter S. J., The little SAS book: a primer, fifth edition. SAS Institute
2. Alan C. Elliott and Wayne A. Woodward, SAS Essentials: Mastering SAS for Data Analytics, Wiley
3. Ron Cody, Learning SAS by Example, Second Edition, SAS Institute

CSE601 Cyber Security

Course Title and Code: Cyber Security**:** CSE601	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech Sem VI (2017-2021)

Course Objective: The course is aimed to prepare students with the skills required to identify, analyze and remediate computer security breaches. This course includes topics like cybersecurity, including network security, cloud security, system security, network infrastructure, protocols, and encryption. This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.

Learning Outcome:

On successful completion of this course, the students should be able to:

- Analyze and evaluate cyber security needs of an organization.
- Design and develop a security architecture for an organization.
- Design operational and strategic cyber security strategies and policies.
- Explore how cyber criminals are using operating system tools to get control.
- Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation and measure the performance and troubleshoot cyber security systems.
- Apply tools used by penetration testers and ethical hackers (network CLI tools, Telnet, SSH, Nmap, Wireshark, and many others).
- Implement cyber security solutions using cyber security, information assurance, and cyber/computer forensics software/tools.
- Manage high-end security enterprise solutions such as: IBM QRadar SIEM, Vulnerability Manager, UBA, IBM QRadar Advisor with Watson, I2 Analyst Notebook and IBM Cloud X-Force Exchange.
- Apply critical threat modeling methodologies and frameworks such as MITRE, Diamond, IBM IRIS, IBM Threat Hunting, and security intelligence approaches to threat management.
- Participate in Security Operation Center (SOC) role-playing scenarios: experiencing research insights through design thinking practices.
- Experience the basis for SOC—enacting the roles of triage analysts, incident response analysts, and threat intelligence analysts.

Prerequisites		**Security Intelligence**
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	**20 (COURSERA 10)**
3	Class Participation	Nil
4	Quiz	**20 TCS ION LX**
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III (IBM Certification Exam)	**25**
8	Report-I	Nil

9	Report-II	Nil
10	Report-III	Nil
11	Project-I	**15**
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	**10**
15	Lab Evaluation-II	**10**
16	Course Portfolio	Nil
	Total (100)	100
Evaluation Scheme for Retest		
1	Theory Exam-III	25
2	Lab Evaluation-II	10
	Total	**35**

Syllabus (Theory)

UNIT I – CYBERSECURITY LANDSCAPE

Cybersecurity in the World Today, Cyber Threats Taxonomy, Cybersecurity Domains CYBER RESILIENCE FRAMEWORK & LIFECYCLE: Cybersecurity Industry Challenges, Cyber Resilience Frameworks, Cyber Resilience Lifecycle

IDENTIFY CYBER ATTACK: Threat Landscape, Anatomy of a Cyber Attack, Threat Hunting Methodology

SOC IN ACTION: Security Operation Centers (SOC) Overview, SOC Operations Team, SOC Incident Lifecycle

UNIT II – NETWORK SECURITY

Network Security Landscape, Enterprise Network Security, Anatomy of a Network Attack

MOBILE & IOT SECURITY: Mobile & IoT Global Trends, Mobile & IoT Security Landscape, End-point Protection

APPLICATION SECURITY: Introduction to Web Applications, Application Security Practices, Application Security Attacks

UNIT III – DATA SECURITY

Data Breaches – Industry Overview, Insider Threat and Phishing Attacks, Ransomware and Fraud Attacks, Industry Case Study

CLOUD SECURITY: Cloud Global Trends, Cloud Security Challenges, Cloud Security in Practice, Industry Case Studies

SECURITY INTELLIGENCE: SIEM Landscape, SIEM Characteristics, SIEM in Action, SIEM Explained, SIEM Identifies a Phishing Attempt, Using the SIEM

Syllabus (Lab)

MONITORING GLOBAL SECURITY: Explore interactive security threats, Monitor global attacks in real-time

NETWORK SECURITY TOOLS: Understand the data behind your IP, explore your Command Line Interface, learn about basic tools attackers use, Cement industry best practices such as DNS

ENDPOINT SECURITY PRACTICES: Foot printing and how to find vulnerabilities, witness how an attacker takes control, protect yourself using Secure Shells, discover how X-Force keeps tabs online

WEB BANKING DATA BREACH SCENARIO: Understand role of a penetration tester, discover more methods to attack a system, Conceptualize repercussions of attacks

SCAN AND INVESTIGATE VULNERABILITIES: Create and run a patch scan, adjust impact scores for important assets, run a custom scan with active tests, Investigate a vulnerability
USING IBM QRADAR: Navigate the web interface, investigate suspicious activity, create a report, Manage network hierarchy
INVESTIGATING USER BEHAVIOR: Validate environment, run log events to generate user traffic, configure rules, Modify User Behavior Analytics, Investigate users
ANALYZING THREATS WITH INTEL: Prepare data in QRadar, trigger an offense and import into i2, Use ANB to perform investigation, import data into i2 Analyst’s Notebook, examine human resource data

Textbooks:

- T1. Li, Qing, and Gregory Clark. Security Intelligence: A Practitioner's Guide to Solving Enterprise Security Challenges. John Wiley & Sons, 2015.
- William Stallings, “Cryptography and Network Security: Principals and Practice”, Pearson Education.
- Kamath Nandan, “Law Relating to Computers Internet & E-commerce (A Guide to Cyber laws & the Information Technology Act, Rules, Regulations and Notifications along with Latest Case Laws)”, 2012, Universal Law Publishing, 2016
- Hsu, D. Frank, and Dorothy Marinucci, eds. Advances in cyber security: technology, operations, and experiences. Oxford University Press, 2012.
- Geers, Kenneth. Strategic cyber security. Kenneth Geers, 2011.

Reference Books:

4. Johnson, Loch K. National security intelligence. John Wiley & Sons, 2017.
5. Roberts, Scott J., and Rebekah Brown. Intelligence-Driven Incident Response: Outwitting the Adversary. " O'Reilly Media, Inc.", 2017.
6. S.K. Verma and Raman Mittal, “Legal Dimensions of Cyber Space”, Universal Law Publishing, 2004

Course Title and Code: Electrical Safety (EE611) (Open Elective-I)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	**All B. Tech Students**

Course Objective:
The goal of this course is to discuss electrical hazards, Safety standards, protection issues, identification of sensors for protection and develop understanding of the CEA regulations for Electrical safety. This course will facilitate students to find solutions of electrical hazards.

On successful completion of this course students will be able to:

1. Identify the hazards associated with electricity: shock and fire.
2. Investigative the cause of electrical accidents and fires.
3. Identify and explain how to respond to electrical emergencies.
4. Identify safe work practices when exposed to electrical hazards (including risk assessment)
5. Apply the acts in accordance with the risk and safety issues, legal obligations codes of safety practice.
6. Explain the Indian electricity safety code and rules
7. Plan and take measures to minimize hazards
8. Formulate the suitable methodologies to determine safety risks in relevant practical applications.
9. Review the design of existing electrical systems as per the standard electrical safety code.
10. Integrate the sensors for the monitoring and automation of electrical systems.

Prerequisites		Basics of Electrical Engineering,
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	-
2	Assignment	05
3	Class Participation	05
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	05
9	Report-II	05
10	Report-III	-
11	Project-I	10
12	Project-II	10
13	Project-III	-
14	Lab Evaluation-I	-
15	Lab Evaluation-II	-
16	Course Portfolio	-
	Total (100)	100

Syllabus (Theory)

UNIT I: Concepts and Statutory Requirements

Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference –Working principles of electrical equipment -Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety –first aid-cardiopulmonary resuscitation (CPR).

UNIT II: Electrical Hazards

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-

Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation –earthing, specifications, earth resistance, earth pit maintenance.

UNIT III: Protection Systems

Fuse, circuit breakers and overload relays –protection against over voltage and under voltage –safe limits of amperage –voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment –safety in handling handheld electrical appliances tools and medical equipment.

UNIT IV: Selection, Installation, Operation and Maintenance

Role of environment in selection-safety aspects in application -protection and interlock-self diagnostic features and fail-safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.

UNIT V: Hazardous Zones

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

Reference Books:

1. Mary Capelli-Schellpfeffer, Dennis Neitzel, John Cadick, Al Winfield, “Electrical Safety Handbook” McGraw-Hill Education.
2. Mohamed A. El-Sharkawi, “Electric Safety: Practice and Standards” CRC Press.
3. Krishnan, N.V., Safety Management in Industry, Jaico Publishing House,
4. Cooper W.F., Electrical Safety Engineering, Newnes.
5. Cadick, J., et. al., Electrical Safety Handbook, McGraw Hill Education.
6. Bureau of Indian Standards, National Electrical Code 2011, Bureau of Indian Standards, New Delhi, 2011.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE403	**Energy Sources**	**3**	**1**	**2**	**0**	**5**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	**Mid Term Test – II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation**	**Total Marks**	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation**	**Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I TARIFFS & SELECTION OF POWER PLANTS: Tariff and types of tariffs, comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant, Selection and location of power plants.
UNIT II POWER PLANTS: HYDRO POWER PLANT: Ecological aspects, Choice of site, Hydrology, Mass curve, flow duration curve, water storage, classification of hydroelectric plants, pumped storage plants, operating cost. **THERMAL POWER PLANT:** Choice of site, arrangement of plant and principal auxiliaries, main electrical equipments, instrumentation, speed governor, operating cost.
NUCLEAR POWER PLANT: Nuclear Physics, moderator materials, Fission & Fusion reactions, types of reactors, main components of nuclear power plant, operation and control of reactors, choice of site, Comparison of various Power Plants.
UNIT III POWER PLANT ECONOMICS: Economic Aspects of Power Plant Operation, methods of depreciation, effect of load factor, demand and diversity factors, power factor improvement.
UNIT IV NON-CONVENTIONAL ENERGY SOURCES-MAIN SOURCES: Introduction, availability, classification, relative merits and demerits. **SOLAR ENERGY:** Theory of solar cells, solar cell array, solar power plant, limitations, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **WIND ENERGY:** Wind power, site selection and criterion, classification of rotors, wind characteristics, Performance and limitations of energy conversion systems.
UNIT-V NON-CONVENTIONAL ENERGY SOURCES-OTHER SOURCES Geothermal energy, Magneto-hydrodynamics (MHD, Fuel Cells, Biomass, Ocean thermal energy conversion, waves and tidal waves.

Syllabus (Practical)

1. Measure of solar irradiance Intensity.
2. Study of solar energy trainer and solar panel.
3. Calculation of power and load for solar voltaic system.
4. Study of solar battery charger with MPPT technique.
5. Study of wind training system.
6. Study of bio-energy training system.
7. Study of fuel cell trainer.
8. Modeling and simulation of hybrid energy system.
9. Modeling and simulation grid connected hybrid energy system.
10. Modeling and simulation solar PV module.

Text Book(s)

1. Generation of Electrical Energy –B.R. Gupta.
2. Non-Conventional Energy Sources-G.D. Rai-Khanna Publication.
3. Raja etal, "Introduction to Non-Conventional Energy Resources" SciTech Publications.
4. Power System Engineering – I. J. Nagrath & D.P. Kothari.

Reference Book(s)

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
3. D.S. Chauhan," Non-conventional Energy Resources" New Age International.
4. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
ECE480	**Industrial IoT**	**3**	**0**	**2**	**0**	**3**

Course Objective: This course is an introduction to the key components that make up an Industrial IoT system. Good practices, protocols and standards employed at each layer of the IIoT stack are introduced.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Explain the key components that make up an Industrial IoT system and differentiate between Internet of Things (IoT) and Operational Technology (OT).
2. Discuss protocols and standards employed at each layer of the IIoT stack.
3. Design, deploy and test a basic Industrial IoT system, including data analysis functionalities.
4. Apply best practices in order to meet desired requirements for IIoT applications.
5. Analyze the environmental effects and incorporate robustness in design of IIoT system.
6. Choose technology for constrained nodes and network while maintaining real time data collection.
7. Explain the importance of cybersecurity for IIoT networks

Assessment Scheme

Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	Nil
04	Quizzes	15
05	Theory Exam-I	20
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report -1	Included with Project 1
11	Project -1	20
15	Lab Evaluation	15
16	Course portfolio	Nil
	Total (100)	**100**

Course Syllabus

Unit 1 IoT Fundamentals

IoT definition. Opportunities and challenges. Characteristics. Physical and logical design. Protocols. Security and safety. Use cases.

Unit 2 IIoT Fundamentals

Industrial communication: principles, protocols and technologies. IIoT definition, architectures and use cases. Convergence of IT and OT. Design methodology.

Unit 3 HMI and SCADA systems

Elements of HMI and SCADA systems. Typical architecture. Life cycle. Standards.

Unit 4 Data Analytics

Basic concepts and technologies. Applications: Predictive maintenance. Smart factories. Smart transportation.

Practical work: Design and test a basic IIoT system involving prototyping, programming and data analysis.

Textbooks:

1. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach. Vpt, 2014.

2. Hanes, David, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things. Cisco Press, 2017.
Reference book: 1. Gilchrist, Alasdair. Industry 4.0: the industrial internet of things. Apress, 2016**.**

Course Title and Code Critical Interpretation of Literature and Cinema: HS401 (Open Elective-I)	
Hours per Week	**L-T-P: 3 0 0**
Credits	**3**
Students who can take	**B. Tech Semester-IV (Batch: 2017-21) and Semester-VI (Batch: 2016-20) / Elective**

Course Objective:
This course is designed to familiarize the students with various literary approaches to appreciate a literary text and expand the literary and cultural knowledge of students in relation to well-known literary texts and their film adaptations.

Learning Outcomes:
On successful completion of this course, the students should be able to:
1. Critically analyze literary texts using classical (Plato, Aristotle, Dryden etc.) and contemporary (Sigmund Freud, Carl Jung, Elaine Showalter) literary approaches.
2. Connect a work of fiction to its film adaptation or to a cultural phenomenon and historical event.
3. Identify similarities and differences between film art and various literary genres.
4. Apply various literary devices and cinematic techniques to analyze literature and cinema respectively.
5. Compare and contrast various films in terms of their narrative form, style and visual language.

Sr. No	Specifications	Marks
01	Attendance	10
02	Assignment	20
03	Class Participation	10
04	Quiz/case study	10
05	Theory Exam-I	10
06	Theory Exam-II	NIL
07	Theory Exam-III	25
08	Report-I	NIL
09	Report-II	NIL
10	Report-III	NIL
11	Project-I	15
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
	Total (100)	**100**

Syllabus:
Significance of Literature and Cinema
Interpreting Literature through Devices such as Narrative Technique, Theme, Plot, Action, Characterization, Structure, Unity, Stylistic Features, Figures of Speech such as Simile, Metaphor, Alliteration, Personification, Paradox, Antithesis, Oxymoron, Onomatopoeia, Hyperbole, etc.
Interpreting Cinema through Devices such as Theme, Story and Screenplay, Characteristics, Semiotics, Cinematography and Editing - Time and Space, Narrative, Lighting Sound/Music etc.
Feature Films and Short Films, Documentaries, History of Indian Cinema, actors and personality, cults, mythological films, major turning points and trends in cinema, Parallel cinema in India.
Film Review, Discussions & Presentations on various aspects of Cinema and Literature
Analyzing Selected Poems, Short Stories, Plays and Works of Fiction
List of Selected Works: Poems by Robert Frost, Alexander Pope, Short Stories by Chekhov, Katherine Mansfield, and Somerset Maugham; John Osborne's Look Back in Anger, Jhumpa Lahiri's The Namesake

References:

1. Beaver, Frank Eugene, A Dictionary of Film Terms: The Aesthetic Companion to Film Art. New York: Peter Lang, 2006.
2. Bluestone, George, Novels into Films. California: University of California Press, 1957.
3. Hood, John W, The Essential Mystery: Major Film Makers of Indian Art Cinema, Hyderabad: Orient Blackswan, 2009.
4. Hutcheon, Linda, A Theory of Adaptation. Second Ed. New York: Routledge, 2013

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
MA404 (Open Elective-I)	**Random Variables and Stochastic Processes**	3	1	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks
20	20	50	10	100	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Unit 1: PROBABILITY

Introduction, definitions, conditional probability, combined experiments.

Unit 2: RANDOM VARIABLES

Introduction, Distribution and density functions, Discrete and continuous random variables, (Gaussian), Exponential, Rayleigh, Uniform, Bernoulli, Binominal, Poisson, discrete Uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.

Unit 3: MULTIPLE RANDOM VARIABLES

distributions, function of two random variables, Two functions of two random variables, Joint moments, Joint characteristics functions, Conditional distribution s, conditional expected values, statistical independence. Multiple random variables: multiple functions of multiple random variables, jointly Gaussian random variables, sums of random variable, Central limit theorem.

Unit 4: STOCHASTIC PROCESSES

Definitions, Random process concept, Statistics of stochastic processes: mean, auto correlation, strict and wide sense stationary, random processes and Linear Systems.

Unit 5: STOCHASTIC PROCESSES IN FREQUENCY DOMAIN

Power spectrum of stochastic processes, Transmission over LTI systems, Gaussian and White processes, Properties of power spectral density.

Textbooks and Reference books

1. Probability, Random Variables and Stochastic Processes, Papoulis, TMH (2002)
2. Stochastic Processes, 2ed, Ross, Wiley. (1996)
3. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education. (Indian Edition is available).
4. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill. (Indian Edition is available).
5. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International Student Edition.
6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.
8. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course code				Course Title		Teaching Scheme			
						L	T	P	Credits
MA601 (Open Elective-I)				Transform Calculus for Engineers		3	0	0	3

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks
20	20	50	10	100	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Unit 1: Introduction

Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-tooth wave, Euler's formulae, Complex exponential form for Fourier series, Half- and Quarter-Range Expansions

Unit II: Fourier Integral and transform

Fourier Integral, Fourier Transform, Transition from Fourier integral to Fourier Transform, Properties and applications, Characterization of Fourier transform - Paley-Wiener theorems.

Unit III: Discrete Fourier Transform

Discrete Fourier transform, Fast Fourier Transform (FFT), Short-time Fourier transform (STFT): Definition and Interpretations, General Properties. Wigner-Ville transform (WVT), properties of WVD.

Unit IV: Wavelet Transform

Continuous wavelet transform. Time-frequency resolution. Discrete wavelet transform.

Textbooks and Reference books

1. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003). This book deals with mainly Fourier series.
2. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).
3. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc
4. R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesley, 1998.
5. *L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.*

Course Code	Course Title	Teaching Scheme			
		L	**T**	**P**	**Credits**
MA401	**Integral Transforms**	**3**	**0**	**2**	**3**

Course Objectives: The course will develop ability to analyze various integral transforms and apply them in various applications like noise reduction and image compression etc. MATLAB will be used to to visualize the signal modulation.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Construct the kernels of the integral transforms by solving the generalized Sturm-Liouville problems.
- Identify various integral transforms and their applications through their kernels.
- Characterize functions on the basis of piecewise continuity, order and orthogonality.
- Identify different types of wave forms.
- Write various types of expansions like Sine, Cosine, Fourier, Legendre, Chebyshev, wavelet etc. for a given function.
- Analyze fundamental characteristics of continuous time signals using various continuous transforms and discrete time signals using Discrete Fourier Transforms (DFT).
- Apply various properties of transforms like change of scale and Convolution to study various types of signals.
- Analyze small wavelets with limited duration using wavelet transform.
- Evaluate function classes for their suitability to construct transforms.
- Apply computational tools such as MATLAB to visualize the signal modulation.

Assessment Scheme:		
Teaching Scheme (Hours per Week)		L T P 3 0 2
Credits		3
Sr. No	Specifications	Marks
1	Attendance	-
2	Assignment	-
3	Class Participation	20
4	Quiz	-
5	Theory Exam-I	20
6	Theory Exam-II	20
7	Theory Exam-III	40
8	Report-I	-
9	Report-II	-
10	Report-III	-
11	Project-I	-
12	Project-II	-
13	Project-III	-
14	Lab Evaluation-I	-
15	Lab Evaluation-II	-
16	Course Portfolio	-
	Total (100)	100

Course Syllabi (Theory):

Unit 1: Integral transforms

Integral transforms, kernels of integral transforms, construction of kernels of the integral transforms, Properties of integral transform, Convolution theorem, different integral transform and their kernels.
Unit I1: Fourier Integral and transforms
Piecewise continuous functions, order of functions, Orthogonality of functions, special wave forms: Triangular wave, Square wave, Saw-tooth wave etc.
Euler’s formulae, Complex exponential form for Fourier series, Half- and Quarter-Range Expansions. Fourier Integral, Fourier Transform, Transition from Fourier integral to Fourier Transform, Properties and applications.
Discrete Fourier transform: definition and interpretations, general properties.
Unit III: Expansions and transforms
Legendre polynomial, Legendre series expansion, Chebyshev polynomial, Chebyshev expansion, Wavelet function, Wavelet expansions. Continuous wavelet transform. Time-frequency resolution. Discrete cosine transform and its applications in image compression.
Reference Books –
· M. Ya. Antimirov, A. A. Kolyshkin and Remi Vaillancourt, Applied Integral Transforms, American Mathematical Society.
· E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003).
· R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).
· C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc
· R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesley, 1998.
· L.Prasad & S. S. Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

<table>
<tr><th colspan="3" rowspan="2">Course code</th><th colspan="2" rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="3">MA403</td><td colspan="2">Engineering Optimization</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="5">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test –I</th><th>Mid Term Test–II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test-I</th><th>End Term Test</th><th colspan="2">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks **</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td colspan="2">30</td><td>100</td></tr>
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*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I: LINEAR PROGRAMMING PROBLEMS: Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem

UNIT II: NON-LINEAR PROGRAMMING PROBLEMS: Introduction, Single variable and multi variable optimization, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming

UNIT III: PROJECT AND SIMULATION: Simulation, Project Management with CPM/PERT

UNIT IV: OPTIMIZATION MODELS: Basic structure of queuing models, role of the exponential distribution, The birth and death processes, queuing models based on birth and death processes (M/M/1 Model), , Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, Two jobs and m Machines Problems

UNIT V: NETWORK OPTIMIZATION MODELS: The Terminology of Networks, Shortest-Path Problem, Minimum Spanning Tree Problem, Case Study

Syllabus (Practical)

1. Problem solving using various software packages for the following areas.
2. Linear Programming
3. Non-linear Programming
4. Network Optimization
5. Case Study

Textbook(s)/Reference Book(s)

1. S S Rao, Engineering Optimization: Theory and Practices, New Age International, 1996.
2. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.
3. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2003.
4. Ronald L. Rardin, Optimization in Operations Research. Pearson Education, First Indian Reprint 2002.
5. Pant. J. C., Introduction to Optimization: Operations Research, Jain Brothers, 5th Ed., 2000.

6. Sharma. S. D., Operations Research, Kedarnath Ramnath& Co., 15th Edition, 2006.
7. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, PHI.
8. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.

Web Resource(s)

http://nptel.ac.in/courses/111105039/

Course Title and Code Advanced Statistics: AS1202	
Teaching Scheme	L-T-P: 3-0-2
Credits	4

Course Objective

To familiarize students with the fundamentals of probability theory, random variables and random processes so that they can model different processes of communications, signal processing, computer science as stochastic processes and analyze them.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Identify and formulate fundamental probability distributions and density functions.
2. Analyze continuous and discrete-time random variables and processes.
3. To model various real-life processes as stochastic process and analyze them.
4. Compute cumulative distribution function and normalizing constant for the probability density function of a random variable.
5. Apply the concept of algebra of random variables to analyze various linear systems.
6. Compute various important parameters of the resultant random variable to analyze the resultant behavior.
7. Design an experiment as a process and analyze it.

Prerequisites		Introductory Statistics
Evaluation Scheme		
Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	10
04	Quiz	10
05	Theory Exam I	Nil
06	Theory Exam II	15
07	Theory Exam III	25
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	15
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation-1	Nil
15	Lab Evaluation-2	10
16	Course portfolio/MOOC	15
	Total (100)	100

Evaluation Scheme for Re-Test		
1	Theory Exam III	25
2	Lab Evaluation-2	10
	Total	35

Syllabus

RANDOM VARIABLES

Random variables, Distribution and density functions of random variables, Discrete and continuous random variables, Gaussian, Exponential, Rayleigh, Uniform, discrete Uniform and conditional distributions, distribution mean, variance, moments and characteristics functions

MULTIPLE RANDOM VARIABLES

Function of two random variables, Distributions of two random variables, correlation coefficient, Joint moments, Joint characteristics functions, Conditional distributions, conditional expected values, statistical independence. Multiple random variables, distribution of sums of random variables, Central limit theorem

OPERATIONS ON MULTIPLE RANDOM VARIABLES

Mean or expected value of multiple random variables, Variance, standard deviation, moments, Chebyshev's Inequality, moment generating function, characteristic function, covariance, variance of a linear combination of random variables.

DESIGN OF EXPERIMENTS

Analysis of variance, one-way classification, two-way classification, completely randomized design.

STOCHASTIC PROCESSES

Introduction, Stochastic Processes, Classification of a Random process, strict and wide sense Stationarity, cross correlation function, statistical averages, statistical independence, Ergodic random process, Mean Ergodic theorem, correlation functions, covariance functions, random processes and Linear Systems.

Reference MOOC

Probability Theory, Statistics and Exploratory Data Analysis

https://www.coursera.org/learn/probability-theory-statistics

Reference Books:

1. J. Susan Milton and Jesse C. Arnold, ‘Introduction to Probability and Statistics’, McGraw Hill Education.
2. Papoulis, ‘Probability, Random Variables and Stochastic Processes’, TMH.
3. VK Rohatgi and AK Saleh, ‘An Introduction to Probability and Statistics’, Wiley India.
4. Ross, ‘Stochastic Processes’, 2ed, Wiley.
5. H. Stark and J. Woods, ‘Probability and Random Processes with Applications to Signal Processing’, Third Edition, Pearson Education.
6. K. L. Chung, ‘Introduction to Probability Theory with Stochastic Processes’, Springer International Student Edition.
7. P. Kousalya, Probability, Statistics and Random Processes, Pearson.

EE541 Electrical Engineering Systems

Syllabus

Unit-I: Power Sector in India

Introduction to various institutions in Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, state and central governments, REC, utilities and their roles. Critical issues / challenges before the Indian power sector, Salient features of Electricity act 2003, various national policies and guidelines under this act.

Unit-II: Features of Conventional and Renewable Generation

Introduction, Conventional Sources: Coal, Gas and Nuclear, Hydroelectric Power, Wind Power, PV and Solar Thermal Electricity, Tidal Power, Wave Power, Biomass, Power Generation Characteristics, Combining Sources.

Unit-III: Tariff and Power Sector Economic

Tariff: Power tariff, Government policies in force from time to time, Effect of renewable energy and captive power generation on tariff, Tariff for renewable energy.

Power Sector Economic: Cost components and cost structure, Investment options, Internal Rate of Return and Net Present Value of project, marginal costs, financing options, stakeholders, Role of regulation and evolution of regulatory commission in India.

Unit-IV:

Supply System:

Structure of electric power system, AC and DC distributors, primary feeder conductor size, Kelvin's law, Computation of voltage drop, distribution losses.

The Future – Towards a Sustainable Electricity Supply System:

Introduction, Future of Wind Power, Solar Power, Biofuels, Hydro and Marine Power, Distributed Generation and the Shape of Future Networks.

Unit-V: Principles of Power System Protection

General philosophy of protection, Relay terminology, Relay characteristics, Classification of Relays, characteristics and operating equation, Performance of conventional CT/PT as well as capacitive voltage transformers, Protection of motor, transformer and bus-bar, Relay co-ordination.

Course Title and Code CS1201: **Robotic Process Automation**	
Hours per Week	**L-T-P: 2-0-4**
Credits	**4**
Students who can take	B.Tech.(CS/EC/EEE/CE/ME – V+VII, CHE-VII) Odd Sem

Course Objective:

- The course aim is to develop understanding about Robotic Process Automation for automating business processes using software robots with cost efficient digital delivery.

Learning Outcome:

On successful completion of this course, the students should be able to:

- Use and understand the various functionalities and features of UiPath Studio and Orchestrator.
- Design, implement, and use RPA activities.
- Develop basic robots using UiPath Community Edition.
- Explore various data extraction techniques.
- Deploy, monitor and control robots with UiPath Orchestrator.
- Identify processes which can be automated.
- Apply best practices in RPA projects.

Prerequisites: To understand and complete the course successfully the student must have basic programming skills.

Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignments	20
03	Class Participation	10
04	Quiz	10
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam(Final)	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project-1	20
12	Project-2	20
13	Project-3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	Nil
16	Course portfolio	20
	Total (100)	**100**

Syllabus (Theory):

Unit I: Programming Basic & Recap: Programming concept basic; **Introduction to RPA:** scopes and techniques of automation, RPA components and various RPA platforms, Introduction to UiPath as RPA platform, Applications and Benefits of RPA, Introduction to UiPath Studio, UiPath robot, types of robots, and UiPath Orchestrator. Brief on Studio interface and components.

Unit II: **RPA Projects:** Types of Projects in RPA: Sequence, Flowcharts, and State machines; Variables, Arguments, Data Types and Control flow: flow chart activities and sequences activities. **Data Manipulation:** Text and Data Manipulation**,** Data tables, clipboard management, file operation, importing from and exporting to CSV/Excel file and data table.

Unit III: **Control of Controls:** Attach window activity, Finding the control, Waiting for a control, Act on Control- mouse and keyboard activity. Handling event driven controls as working with UiExplorer handling events. Introduction to Recorder, OCR, types of OCR and Screen Scrapping Using OCR. **Selectors:** Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

Unit IV: **Application with Plugins and Extensions:** Java plugins, Citrix automation, Mail plugins, PDF plugins, Web integration, excel and word plugins. Extensions- Java, chrome, firefox, and Silverlight. **UiPath Advanced Automation concepts and techniques:** Image, Text and introduction of Citrix Automation; **Excel Data Tables & PDF:** Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors. **Email Automation:** Incoming Email automation, Sending Email automation.

Unit V: **Debugging and Exception Handling:** Common exceptions and ways to tackle them, Strategies for solving issues, Catching errors. **Introduction to Orchestrator:** Tenants, Authentication, Robots, Environments, Asset. **Capstone Project.**

Syllabus (Practical):

1. Setup, configuration, and introduction of components of UiPath Studio.
2. Execution of prebuilt examples of sequence, flow chart and state machines projects.

Create a sequence/Flow chart activity defining various types of variable as:

3. Generic Value Variables, Text Variables, Boolean Variables, Number Variables,
4. Array Variables, Date and Time Variables, Data Table Variables Managing Arguments:
5. Create two activities, one activity defined with arguments and second activity which manages the argument to receive value from first activity.
6. Create an activity to manage importing active namespaces.

Create a project to Manage the control Flow:

7. The Assign Activity, The Delay Activity, The Do While Activity, The If Activity

8. The Switch Activity, The While Activity, The For-Each Activity, The Break Activity.

The Recording toolbar Activity:

9. Exercises using basic, web, and Desktop recoding.

10. Automate manual recording projects on Left-click on buttons, check boxes, drop-down lists, GUI elements, and Text typing

Data Scrapping:

11. Bot to extract structured data from your browser, application or document to a database, .csv file or even Excel spreadsheet.

12. Image and Text Automation

13. Excel Data Tables & PDF

14. Email Automation

15. Deployment of plugins and extensions.

16. Deploying and maintaining the BOT.

Textbooks:

T1 Tripathi, Alok Mani. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath. Packt Publishing Ltd, 2018.

T2. Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant." Middletown, DE. Omakustanne (2018).

Reference Books:

R1. Abhinav Sabharwal, “Introduction To RPA”, Independently Published Kindle Edition on Amazon Asia-Pacific Holdings Private Limited, 201 8

R2. Gerardus Blokdyk, “Rpa Robotic Process Automation”, 5Starcook, Second Edition, 2018

R3. Kelly Wibbenmeyer, “The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization” Paperback, iUniverse, 2018

R4. Willcocks, Leslie P., Mary Lacity, and Andrew Craig. "The IT function and robotic process automation." (2015).

Course code	Course Title	Teaching Scheme			
		L	**T**	**P**	**Credits**
EE542 Open Elective-II	Renewable Energy Systems	**3**	**0**	**2**	**4**

Syllabus:

Overview of conventional energy sources, introduction to renewable energy resources, sector-wise energy consumption in India, historical review of renewable energy, solar irradiation on earth, solar thermal devices and storage, solar photovoltaic system and devices, wind energy technologies and geographical aspects, geothermal and biomass, basics of batteries and its types, performance comparison of batteries and usages, Fuel cell and its types, flywheels and super capacitors. Solar Photovoltaic Energy System (IEC TC82)

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
AS1201	**Operations Research**	**3**	**0**	**2**	**0**	**4**

Course Objectives: This Course aims to develop various concepts and tools to help students understand the operations research and mathematical modeling methods.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Determining the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.
2. Formulate and translate a real-world problem, given in words, into a mathematical formulation.
3. Use these tools to analyze strategic, tactical and operational supply-chain decisions including facility location, vehicle routing and inventory management
4. Improve decision making by identify minimize trouble spots by identifying the critical factors.
5. Find reliability and operation analysis which includes system reliability analysis, failure investigation and corrective action.
6. Know how to work in a team, specifically to solve larger problems, communicate technical knowledge, partition a problem into smaller tasks, and complete tasks on time.

Assessment Scheme:

Prerequisites		**Operations Research**
Teaching Scheme (Hours per Week)		L T P 3 0 2
Credits		4
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-1	20
6	Theory Exam-2	Nil
7	Theory Exam-3	40
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Case Study – 1/ Project-1/Research Paper-1	20
12	Case Study – 2/ Project-2/Research Paper-2	Nil
13	Case Study – 3/ Project-3/Research Paper-3	Nil
14	Lab Evaluation-1	Nil
15	Lab Evaluation-2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Course Syllabi (Theory):

Unit – I: Decision Analysis

A Prototype Example, Decision Making without Experimentation, Decision Making with Experimentation, Decision Tress

Unit – II: Markov Chain
Introduction to Markov Chain, Stochastic Processes, Chapman-Kolmogorov Equations, Classification of States of Markov Chain

Unit – III: Supply Chain Analysis and Inventory Management
Introduction, Introduction to Supply Chain Management and Supply Chain Strategy, Supply Chain Performance Metrics and Drivers Objectives of Inventory Control, Types of Inventory

Unit – IV: Network Optimization Models
The Terminology of Networks, Shortest-Path Problem, Minimum Spanning Tree Problem, Project Management with CPM/PERT

Unit – V: Reliability Theory
Introduction, System Reliability, Failure Rates, Bathtub, Reliability of Systems, Practical Utility of Reliability Evaluation

Course Syllabi (Practical):
Problem solving using various software packages for the following areas.

9. Markov Chain
10. Supply Chain Analysis
11. CPM/PERT
12. Reliability Theory

References:

1. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., 2010 Ed. TMH.
2. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.
3. Srinivasan, G., OPERATIONS RESEARCH: PRINCIPLES AND APPLICATIONS, PHI Learning Pvt. Ltd, 2007.
4. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2017.
5. Ackoff, R.L. and Sasini, M. W., Fundamentals of Operations Research, Wiley & Sons, New York.
6. Waddington, C. H., O. R. in World War 2: Operational Research Against the U-boat, London, Elek Science, 1973.

Course Title and Code Competitive Programming: CS1206			
Hours per Week	**L-T-P: 1-0-2**		
Credits	**2**		
Students who can take	B.Tech. (CS, EE, ECE) Even Sem (VI)		
Course Objective- This Course is designed to equip learners with skills of computational problem solving with a focus on time and space efficiency. It includes analysis, selection, implementation, optimization and scalability of algorithms.			

Learning Outcome:

On successful completion of this course, the students should be able to:

- Identify the algorithmic way of solving problem
- Select an effective data structure and algorithm to efficiently solve the problem
- Analyze Time and Space Complexity of Solution
- Analyze Scalability of Solution
- Attempt an online/onsite national/international computational problem-solving contest.
- Organize an online/onsite national/international computational problem-solving contest/event
- Adapt Ethical Coding Practices

Prerequisites		**Nil**	
Sr. No	**Specifications**	**Marks** (Pre-Covid)	**Marks** (Post-Covid)
01	Attendance	10	10
02	Assignments	Nil	Nil
03	Class Participation	10	Nil
04	Quiz	20	20
05	Theory Exam	Nil	Nil
06	Theory Exam	Nil	Nil
07	Theory Exam (Final)	Nil	Nil
08	Report-1	Nil	Nil
09	Report-2	Nil	Nil
10	Report-3	Nil	Nil
11	Project-1	Nil	Nil
12	Project-2	Nil	Nil
13	Project-3	Nil	Nil
14	Lab Evaluation-1	10	15
15	Lab Evaluation-2	10	15
16	Course portfolio	40	40
	Total (100)	**100**	**100**

Retest Evaluation Scheme		
1	**Quiz**	**20**
2	**Lab Evaluation-2**	**10**
	Total (30)	**30**

Syllabus (Theory)

Review of Concepts of programming (C/Java/C++/Python); Preparing Game Plan for a Contest; Programming Language selection for a contest;

Essential Data Structures for Implementing Solution to a problem (Array, Linked list, Stack, Queue, Trees (Binary, BST, AVL), Heap, Hashing;

Input /Output Techniques and constraints; Test Case analysis of a problem; Hands-on problem-solving approaches (Brute Force Method, Greedy Algorithms, Dynamic Programming);
Complexity analysis of an algorithm; Importance of Graph algorithms;
Meet-up on ACM/Competitive Programming Problems; Common Codes/Routines for Programming; Time Savor: use of various libraries like Standard Template Library (STL) and python supported libraries;
Exploring the working of programming judges; Setting up the online and onsite judge (Codechef, Hackerrank, Hackerearth, Geeksforgeeks, CodingNinjas, PC^2, SPOJ etc.);
Contest Administration; Ethical coding (awareness of Plagiarism).

Reference book(s)

1. Laaksonen, Antti. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests. Springer, 2018.
2. Laaksonen, Antti. "Competitive Programmer’s Handbook." Preprint (2017).
3. Horowitz, Ellis. Fundamentals of data structures in C++. Galgotia Publications, 2006.
4. Skiena, Steven S. The algorithm design manual: Text. Vol. 1. Springer Science & Business Media, 1998.
5. Mata-Toledo, Ramon A., and Pauline K. Cushman. Schaum's outline of Introduction to Computer Science. McGraw Hill Professional, 2000.
6. Narasimha, Karumanchi. "Data Structures and Algorithms Made Easy." (2018).
7. Lafore, Robert. Object-oriented programming in C++. Pearson Education, 1997.

Course code		**Course Title**		**Teaching Scheme**				
				L	**T**	**P**	**Credits**	
PH501 (Open Elective-II)		**Nanotechnology**		**3**	**0**	**0**	**3**	
Evaluation Scheme (Theory)					**Evaluation Scheme (Practical)**			
Mid Term Examination– I (Marks/Weightage)	**Mid Term Examination – II (Marks/Weightage)**	**End Term Examination (Marks/Weightage)**	**Internal Assessment (Marks/Weightage)**	**Total (Marks/Weightage)**	**Mid Term Examination (Marks/Weightage)**	**End Term Examination (Marks/Weightage)**	**Internal Assessment (Marks/Weightage)**	**Total (Marks/Weightage) ****
40/20%	40/20%	80/40%	40/20%	200/100 %	-	-	-	-

*Internal Assessment: Mini project/Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Course Description:
This course will provide understanding of science behind the properties exhibited by materials at nanoscale. The course introduces several advanced concepts and topics in the rapidly evolving field of nanotechnology. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications.

Syllabus (Theory)

Unit 1: Band structure, Density of States and Behavior at Nanoscale
Energy bands, Direct band gap and Indirect band gap, Density of states at low dimension structures, Optical Properties: Absorption/Reflection/Transmission coefficient, Tauc relation, Electrical transport phenomenon in metals, semiconductors and insulators, Mechanical properties

Unit 2: Introductory Quantum Mechanics for Nanoscience
Size effects in smaller systems, Quantum behavior at nanomaterials, de Broglie hypothesis, uncertainty principle, Schrodinger equations, Quantum confinement, Quantum wells, quantum wires and quantum dots Systems.

Unit 3: Growth techniques of Nanomaterials
Bottom-up approach vs Bottom-down approach, Lithographic vs non-lithographic techniques, Thermal deposition/Sputtering, Chemical vapor deposition, E-beam Lithography/Screen printing, Ball Milling.

Unit 4: Nanoscale Characterization Techniques
X-ray diffraction (XRD): size, strain analysis, Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM).

Unit 5: Novel materials and applications
Carbon nanostructures (Carbon Nanotubes, Graphene, Fullerenes etc.), Semiconducting nanomaterials, Nanocomposites, Device fabrication for energy storage, smart sensors, solar cells, etc.

Pre-requisite:
Knowledge of basic science

Reference Books:

1. Nanoscience and Nanotechnology, M.S. Ramachandra Rao, Wiley, 2016
2. Charles Poole and Frank Owens, Introduction to Nanomaterials, Wiley 2007
3. Nanotechnology: Principles and Practices, Sulbha Kulkarni, Springer 2015

4. Handbook of Nanotechnology, Bharat Bhusan, Springer 2017
5. Nano-technology- Molecularly Designed Materials, G. M. Chow & K. E. Gonsalves, (American Chemical society).

Course Title and Code: Soft Computing: CS1202			
Hours per Week		**L-T-P: 3-0-2**	
Credits		**4**	
Students who can take		Sem VII (2016-2020)	
Course Objective: This course introduces the fundamental concepts of soft computing techniques and their applications in building intelligent machines. The course will cover fuzzy logic, genetic algorithms, neural networks and their applications to handle uncertainty, optimization, classification and regression problems.			
Learning Outcome: On successful completion of this course, the students should be able to: 1. Recognize the feasibility of applying a soft computing technique for a particular problem 2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems 3. Apply genetic algorithms to combinatorial optimization problems 4. Apply neural networks to pattern classification and regression problems 5. Effectively use existing software tools to solve real life problems using a soft computing approach			
Prerequisites			Java or Python, DS, DAA
Sr. No	Specifications		Marks
1	Attendance		Nil
2	Assignment		Nil
3	Class Participation		10
4	Quiz		Nil
5	Theory Exam I		10
6	Theory Exam		Nil
7	Theory Exam (End Term)		30
8	Report-1		Nil
9	Report-2		Nil
10	Report-3		Nil
11	Project -1		20
12	Project -2		20
13	Project -3		Nil
14	Lab Evaluation1		Nil
15	Lab Evaluation2		10
16	Course portfolio		Nil
	Total (100)		100

Course Syllabi (Theory):

- Introduction; Introduction to Soft Computing, Concept of computing systems. "Soft" computing versus "Hard" computing, Characteristics of Soft computing, applications of Soft computing techniques
- Introduction to Fuzzy logic. Fuzzy sets and membership functions, Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Applications of Fuzzy logic.
- Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures.GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs. Multi-objective Optimization Problem Solving. Concept of multi-objective optimization problems (MOOPs) and issues of solving them. Multi-Objective Evolutionary Algorithm (MOEA).

- Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving. Different ANNs architectures. Training techniques for ANNs. Applications of ANNs to solve some real-life problems.
- Deep Learning: Recurrent Neural Network Tensorflow, Convolution Neural Network, Application of Deep Learning

References

- Fuzzy Logic: A Practical approach, F. Martin, McNeil, and Ellen Thro, AP Professional, 2000.
- An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
- Genetic Algorithms in Search, Optimization and Machine Learning, David E. Goldberg, Pearson Education, 2002.
- Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
- Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
- Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.

Course Title and Code: Blockchain Technology and Applications CS1203	
Hours per Week	**L-T-P:3-0-2**
Credits	**4**
Students who can take	**B. Tech (VII Sem) Elective**

Course Objectives: This course aims to provide an understanding of the essential concepts of blockchain technology by initially exploring the Bitcoin protocol followed by the Ethereum protocol to lay the foundation necessary for developing applications and programming for Blockchain Technology.

Learning Outcome: On successful completion of this course, the students should be able to:

1. Recognize foundational concepts of blockchain and apply these program concepts on the blockchain.
2. Develop, Test and Execute a smart contract.
3. Apply the consensus mechanism on application.
4. Identify use cases and develop, execute and test the application.
5. Recognize the differences between the most prominent blockchain structures and permissioned blockchain service providers.

Evaluation Scheme:

Prerequisites		**Basic Programming**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	10
03	Class Participation	10
04	Quiz	10
05	Theory Exam – 1 (Block Chain Basics-MOOC from coursera)	10
06	Theory Exam – 2	Nil
07	Theory Exam -3	20
08	Report-1	20
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	20
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	Nil
	Total (100)	100

Retest: -

1	Theory Exam -3	20
2	Lab	Nil

Course Contents

Introduction to Blockchain: - History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: - Basic crypto primitives: Hash, Signature, Hash chain to Blockchain, Basic consensus mechanisms: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols. Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains. Ethereum network, EVM, Transaction fee, Ether, gas, Solidity.

Smart contracts Use case I: Blockchain in Financial Software and Systems (FSS): (a) Settlements, (b) KYC, (c) Capital markets, (d) Insurance. Use case II: Blockchain in the trade supply chain: (a) Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc. Blockchain Cryptography. Research aspects I (a) Scalability of Blockchain consensus protocols (b) Case Study various recent works on scalability, Research aspects II (a) Secure cryptographic protocols on Blockchain (b) Case Study Secured Multiparty Computation, Blockchain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more.

Reference / Textbooks

(1.) Imran Bashir: Mastering Blockchain. O'Reilly, Packt Publishing, 2017.

(2.) Narayanan, Arvind, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. *Bitcoin and cryptocurrency technologies: A comprehensive introduction*. Princeton University Press, 2016.

(3.) Mougayar, William. *The business blockchain: promise, practice, and application of the next Internet technology*. John Wiley & Sons, 2016.

MOOC course

- Blockchain Basics by Coursera (University at Buffalo & The State University of New York)
  https://www.coursera.org/learn/blockchain-basics/home/welcome

Course Title and Code CS1210: Advanced Machine Learning	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Odd Sem (VII)

Course Objective-

The course, Advanced Machine Learning, offered for final year undergraduate aims to develop deeper understanding of machine learning focusing on in-depth coverage of new and advanced methods in machine learning, as well as their underlying theory. It emphasizes approaches with practical relevance and discusses a number of recent applications of machine learning in areas like information retrieval, recommender systems, data mining, computer vision, natural language processing and robotics. An open research project is a major part of the course.

Learning Outcome:

On successful completion of this course, the students should be able to:

- Analyse the loss function and their convergence in various machine learning algorithms.
- Apply important problem-solving techniques like, Stochastic Gradient Descent, Backpropagation, Duality and Regularization in practical applications.
- Demonstrate expertise in Deep Learning, Ensemble Learning and Reinforcement Learning.
- Explore text and image data along with regular tables and graphs.
- Implement a real-life project using Machine Learning techniques.

Prerequisites		**Basic Machine learning, Linear algebra, Probability, Statistics, Python programming**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignments	10
03	Class Participation	Nil
04	Quiz (2)	20
05	Theory Exam	Nil
06	Theory Exam (Mid)	20
07	Theory Exam (Final)	20
08	Report-1	Nil
09	Report-2	Nil
10	Report	Nil
11	Project-1	10
12	Project-2	Nil
13	Project-3	Nil
14	Lab Evaluation (Mid)	10
15	Lab Evaluation (Final)	10
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Quiz	20
2	Theory Exam (Final)	20

Syllabus (Theory)

1 **Introduction:** ML concepts

2 **Stochastic gradient descent:** Error Bounds, Random Forest, Naive Bayes and its convergence

3 **Perceptron Learning:** Learnability, VC dimensions, Occam's Razor Principles, Logistic Regression.

4 **Kernel tricks and regularizations:** Support vector machines (Quadratic optimization), Dual support vector machines.

5 **Backpropagation:** Neural Networks and its accuracies, Convolutional neural networks, Recurrent neural networks.

6 **Graphical models:** Expectation maximization, Bayesian network analysis.

7 **Structure Learning**: Principal components analysis, Clustering (Convergence and Initialization), Ranking

8 **Ensemble Learning:** Bagging, Boosting and Stacking

9 **Online learning**: Markov decision, k-arm Bandit, Reinforcement learning

Syllabus (Practical)

1. Write Python program to implement stochastic gradient descent (SDG), overfitting, regularization, momentum, kernel learning, convergence, parameter optimization, learning rate and sparse matrix multiplication in standard ML algorithms and explore the efficiency.
2. Implement graphical models listed above.
3. Write program for PCA, K-Means and PageRank.
4. Write python program for ensemble learning algorithms.
5. Implement online learning algorithms.

Text Books:

7. Kevin P. Murphy, Machine Learning – A Probabilistic Perspective, MIT Press, 2012.
8. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
9. Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning", Springer, 2001.
10. Vapnik, "Statistical Learning Theory", Wiley, 1998.
11. Tom Mitchell, "Machine Learning", McGraw Hill, 1997.

Reference Courses:

1. Advance Machine Learning CS6780 - Advanced Machine Learning. Spring 2019. Prof. Thorsten Joachims Cornell University. https://www.cs.cornell.edu/courses/cs6780/2019sp/
2. Machine Learning by Andrew NG. https://www.coursera.org/learn/machine-learning

Reference Materials:

1. Tong Zheng. Solving large scale linear prediction problems using stochastic gradient descent algorithms. Proceedings of the International Conference on Machine Learning (ICML), 2004.

2. Martin Abadi et al. TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems. Preliminary White Paper, 2015. Since this is a white paper and is a bit longer than what we'll usually be reading, we will cover Sections 1, 2, 4.1, 6, and 9 only.
3. Rich Caruana, Steve Lawrence, and C Lee Giles. Overfitting in neural nets: Backpropagation, conjugate gradient, and early stopping. In Advances in Neural Information Processing Systems (NeurIPS), 2001.
4. Sergey Ioffe, Christian Szegedy. Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift. Proceedings of the International Conference on Machine Learning (ICML), 2015.
5. Ilya Sutskever, James Martens, George Dahl, and Geoffrey Hinton. On the importance of initialization and momentum in deep learning. Proceedings of the International Conference on Machine Learning (ICML), 2013.
6. Suyog Gupta, Ankur Agrawal, Kailash Gopalakrishnan, and Pritish Narayanan. Deep learning with limited numerical precision. Proceedings of the International Conference on Machine Learning (ICML), 2015.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1212	**Information Theory, Coding & Cryptography**	**3**	**0**	**2**	**0**	**4**

Course Objectives: This course is designed to disseminate knowledge of information theory and its application to optimize channel capacity and hence design and implement optimal coding techniques for efficient communication via noisy channels. The course also emphasizes various cryptography techniques.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Implement various coding strategies like Huffman Coding, Turbo coding, etc.
2. Optimize various codes like Shannon codes, Trellis codes etc.
3. Characterize Error Free Communication Over A Binary Symmetric Channel
4. Analyse Channel Capacity of a Band Limited Continuous Channel
5. Analyse various encryption and decryption standards
6. Analyse security goals, types of attacks, steganography, symmetric and asymmetric key encipherment and implement cryptanalysis
7. Analyse different aspects of digital signature, key management & network layer security Implement IEEE Information Theory Society (ITSOC) standards

Assessment Scheme:

S. No.	**Evaluation Component**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	5
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	Nil
7	Theory Exam-III	30
8	Report I (Case Study)	5
9	Report II	Nil
10	Report III	Nil
11	Project I	Nil
121	Project II	Nil
13	Project III	Nil
14	Lab Evaluation I (Continuous)	10
15	Lab Evaluation II (Exam)	10
16	Course Portfolio (MOOC)	10
	Total (100)	**100**
Evaluation Scheme for Re-Test		
1	**Theory Exam - III**	30

2	**Lab Evaluation - II**	10
	Total (40)	**40**

Syllabus (Theory):

UNIT 1: Introduction to Information Theory Society (ITSOC) standards, Information Measure and Entropy, Markov Source, Properties of Joint and Conditional Information Measures, Asymptotic Properties of Entropy and Problem Solving in Entropy, Block Code and its Properties, Instantaneous Code and Its Properties, Kraft-McMillan Equality and Compact Codes

UNIT 2: Shannon's First Theorem, Coding Strategies, Huffman Coding and Proof of Its Optimality, Competitive Optimality of the Shannon Code, Non-Binary Huffman Code, Adaptive Huffman Coding, Reliability-Based Soft-Decision Decoding Algorithms for Linear Block Codes, Trellis-Based Soft-Decision Decoding Algorithms for Linear Block Codes

UNIT 3: Shannon-Fanon-Elias Coding, Arithmetic Coding, Information Channels, Equivocation and Mutual Information, Properties of Different Information Channels, Turbo Coding, Low-Density Parity Check Codes

UNIT 4: Properties of Mutual Information and Introduction to Channel Capacity, Calculation of Channel Capacity for Different Information Channels, Shannon's Second Theorem, Error Free Communication Over Noisy Channel, Error Free Communication Over A Binary Symmetric Channel, Continuous Sources and Channels

UNIT 5: Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels, Channel Capacity of a Band Limited Continuous Channel, Introduction to Rate-Distortion Theory, Definition and Properties of Rate-Distortion Functions, Calculation of Rate-Distortion Functions, Computational Approach for Calculation of Rate-Distortion Functions

UNIT 6: Cryptography: Security Goals, types of attacks, steganography, symmetric and asymmetric key encipherment, cryptanalysis, $GF(2^n)$ Fields, modern block ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES), message integrity and authentication, hash functions, digital signature, key management, network layer security

Syllabus (LABORATORY):

1. Implementation of Cipher Encryption and Decryption
2. Implementation of one time padding for maintaining secrecy
3. Implementation of message authentication codes
4. Application of cryptographic hash functions
5. Implementation of symmetric key Data Encryption Standard (DES)
6. Implementation of symmetric key Advanced Encryption Standard (AES)
7. Diffie – Hellman key establishment
8. Public key encryption and decryption
9. Implementation of the RSA algorithm

10. Application of digital signatures

Textbooks:

1. Error Control Coding, Shu Lin, Daniel J. Costello, 2/e Pearson India, 2011
2. Cryptography and Network Security, Behrouz Forouzan, Debdeep Mukhopadhyay, Tata McGraw Hill, 2010
3. **Modern Digital and Analog Communication Systems, B.P. Lathi**, Oxford University Press, 4/e, 2017

Reference Books:

1. Communication systems engineering, J. G. Proakis and M.Salehi, Prentice Hall, 2002
2. Cryptography and Network Security Principles and Practices, William Stallings, 4/e, Prentice Hall, 2005

MOOCs:

1. **https://www.coursera.org/learn/crypto-info-theory**
2. **https://www.coursera.org/learn/information-theory**
3. **https://www.coursera.org/specializations/applied-crypto**

Other Web Resources:

1. https://nptel.ac.in/courses/108/102/108102117/
2. https://freevideolectures.com/course/3052/information-theory-and-coding/27 - *Error Free Communication Over Noisy Channel*
3. https://tbc-python.fossee.in/book-details/961/

Course Title and Code: Computing Using Python: CSE555		
Course Description In this computer science course, students will learn about foundational computing principles, such as how to write and read computer code and how to run and debug code. Students will learn about general principles of programming like procedural programming, control structures, and data structures in Python. Demonstration of computing principles and domain applications that use programming concepts and computing principles in real applications would be done in this course.		
Prerequisites		**Nil**
Hours per Week		**L-T-P: 2-0-4**
Credits		**4**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	20
03	Class Participation	10
04	Quiz	Nil
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam (Final)	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	20
13	Project -3	Nil
14	Lab Evaluation1	30
15	Lab Evaluation2(Final)	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

gitHub, Functions, Booleans and Modules, Sequences, Iteration and String Formatting, Dictionaries, Sets, and Files, Exceptions, Testing, Comprehensions, advanced Argument Passing, Data Frames, Libraries, Lambda -- functions as objects, Object Oriented Programming, More OO -- Properties, Special methods, Iterators, Iterables, and Generators, Decorators, Context Managers, Regular Expressions

Reference / Textbooks

1. William Punch, Richard Enbody, ‘The Practice of Computing Using Python’ Pearson, 2016
2. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, No Starch Press
3. Mark Lutz, Learning Python, O’Reilly,2013

CS1205

Course Title and Code Mobile Application Development: CS1205	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech Sem-V (CSE)

Course Objectives: This Course is designed to offer learners an introduction to Android platform and related applications in the business world. Learners would be introduced to different cross platforms like IONIC, REACT NATIVE, and TABRIS.JS. The Course will cover ethical contents and security related issues in app deployment at Google Play Store. All techniques will be illustrated using different app design with real-time and static databases.

Learning Outcome:

On successful completion of this course, the students should be able to:

1. develop high-level plans for script solutions for mobile and evaluate the post-production outcome;
2. design scripts to meet given interface and media control requirements;
3. use variables, properties and other code elements appropriately to implement the code design;
4. devise, carry out and evaluate functional test strategies of mobile design;
5. implement and evaluate techniques for the installation of mobile applications and delivery via various channels;
6. explain the principles of technologies which support media production and delivery on a variety of platforms;
7. create event listeners for responding to events;
8. administer permissions and Android manifests;
9. integrate Android XML resources with Java code;
10. create a Google Play Store account and preparing apps for the Play Store.

Prerequisites		**Basics of Computer Networks**
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	**20 (Coursera)**
3	Class Participation	Nil
4	Quiz	**10 (Google Classroom)**
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	**30**
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	**30**
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	**10**
16	Course Portfolio	Nil
	Total (100)	**100**

Re-Test Evaluation		
	Theory Exam-III	**30**
	Total:	**30**

Syllabus (Theory)

Module I – Mobile Application Overview

Introduction to Mobile Computing, Introduction to Android Development Environment, Mobile Software Engineering, Design of application (view level).

Module II – Framework and User Interface Development

Frameworks and Tools, Generic UI Development, Android User (privileges), VUIs and Mobile Apps Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodial UIs, Android Intents and Services, Characteristics of Mobile Applications

Successful Mobile Development.

Module III – Storing Retrieving Data with Real-time Database

Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider, Communications Via Network and the Web, State Machine, Correct Communications Model, Android Networking and Web.

Module IV – Notifications, Alarming and Location

Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia, Mobility and Location Based Services.

Text Books and References:

- Android Cookbook, 2nd Edition by Ian F. Darwin Publisher: O'Reilly Media, Inc. Release Date: May 2017
- Sam’s Teach yourself Android Application Development. by Lauren Darcey and Shane Conder: 2012
- Professional Android 4 Application Development by Reto Meier, 2012
- Android Programming for Beginners by John Horton, 31 Dec 2015
- https://developer.android.com/

Routing, Switching and Wireless Essential
(In collaboration with CISCO Academy)

Course Title and Code: CISCO - Routing Switching and Wireless Essential CS1209	
Hours per Week	**L-T-P: 0-0-2**
Credits	**02**
Students who can take	B.Tech Sem VI Semester
Course Objectives: This course aims to provide knowledge of switching technologies and router operations that support small-to-medium business networks and includes wireless local area networks (WLANs) and security concepts. Students learn key switching and routing concepts. They can perform basic network configuration and troubleshooting, identify and mitigate LAN security threats, and configure and secure a basic WLAN.	
Learning Outcome: On successful completion of this course, the students should be able to: • Configure VLANs and Inter-VLAN routing applying security best practices. • Troubleshoot inter-VLAN routing on Layer 3 devices. • Configure redundancy on a switched network using STP and Ether Channel. • Troubleshoot Ether Channel on switched networks. • Explain how to support available and reliable networks using dynamic addressing and first-hop redundancy protocols. • Configure dynamic address allocation in IPv6 networks. • Configure WLANs using a WLC and L2 security best practices. • Configure switch security to mitigate LAN attacks. • Configure IPv4 and IPv6 static routing on routers.	

Prerequisites		**Basics of Computer Networks**
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz (CISCO Chapter Test)	**40**
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III (CISCO Certificate Test)	**40**
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	**10**
15	Lab Evaluation-II	**10**
16	Course Portfolio	Nil
	Total (100)	100
Evaluation Scheme for Retest		
1	Theory Exam-III	40
2	Lab Evaluation-II	10
	Total	50

Syllabus (Theory + Practical)

Basic Device Configuration, Switching Concepts, VLAN’s, Inter-VLAN Routing, STP, Ether channel, DHCPv4, SLAAC and DHCPv6 Concepts, FHRP Concepts, LAN Security Concepts, Switch Security Configuration, WLAN Concepts, WLAN Configuration, Routing Concepts, IP Static Routing, Troubleshoot Static and Default Routes.

Textbooks:

- Lammle, T. (2016). CCNA Routing and Switching Complete Study Guide: Exam 100-105, Exam 200-105, Exam 200-125. John Wiley & Sons.
- Lammle, T. (2013). CCNA routing and switching study guide: exams 100-101, 200-101, and 200-120. John Wiley & Sons.
- Lammle, T. Cisco Certified Network Associate Study Guide. 2nd. Edition

Reference Books:

1. Stallings, W. (2004). Computer networking with Internet protocols and technology. Upper Saddle River, NJ, USA: Pearson/Prentice Hall.
2. Kurose, J., & Ross, K. (2010). Computer networks: A top-down approach featuring the internet. Peorsoim Addison Wesley.
3. Lammle, T. (2011). CCNA Cisco Certified Network Associate Deluxe Study Guide. John Wiley & Sons.

Course Title and Code: UI / UX Design: CS1404	
Hours per Week	**Curated MOOC (approx. 6 hrs. per week)**
Credits	**4**
Students who can take	**B.Tech. CSE**

Course Objective: The UI/UX Design Specialization provides a design-centric approach to user interface and user experience design, and offers practical, skill-based instruction centered around a visual communications perspective, rather than on one focused on marketing or programming alone.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Summarize and demonstrate all stages of the UI/UX development process, from user research to defining a project's strategy, scope, and information architecture to developing sitemaps and wireframes.
2. learn current best practices and conventions in UX design and apply them to create effective and compelling screen-based experiences for websites or apps.
3. Develop a highly demanded web design to human-computer interaction.
4. Use the UI/UX tools as Adobe XD, Adobe Illustrator, InVision, Marvel, Adobe Indesign, and Treejack.

Prerequisites: NA

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	20
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	40
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	10
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Quiz	10
2	Theory Exam (End Term)	20

Course Contents:

Module-I: Introduction to User Interface concepts and Computer Graphics:

What is a User Interface? The Relationship Between UI and UX, Roles in UI/UX, A Brief

Historical Overview of Interface Design, Interface Conventions: Theory, Interface Conventions: Application, Template vs Content, Aesthetics & Functionality.

Module-II: Formal Elements of Interface Design:

Basics of Computer Graphics, Design Before Design, Look and Feel, Language as a design tools, Color and Shape, Imagery, Typography, Icons

Module-III: Active Elements of Interface Design:

Structures, functionality, Compositions of structures, Buttons, Static vs Active, Style vs Speed, states and changes

Module-IV: Composing the Elements of Interface Design:

Invisible Complexity: Making a Whole from Many Parts, Hierarchy of Content, Conventions and Expectations, Structure and Grids, Platforms and Screen Sizes, Putting it All Together: Slice 'n' Dice

Suggested Reading Materials:
BOOKS AND REFERENCES

- Unger, Russ, and Carolyn Chandler. *A Project Guide to UX Design: For user experience designers in the field or in the making*. New Riders, 2012.
- Russ, Unger. *A Project Guide to UX Design: for user experience designers in the field or in the making*. Pearson Education India, 2009.
- Robin, Williams. *The Non-Designer's Design Book, 3/E*. Pearson Education India, 2008.
- Gothelf, Jeff. *Lean UX: Applying lean principles to improve user experience*. " O'Reilly Media, Inc.", 2013.
- Preece, Jennifer, Helen Sharp, and Yvonne Rogers. *Interaction design: beyond human-computer interaction*. John Wiley & Sons, 2015.

This course would be delivered on COURSERA from 27th July, 2020 to 17th December, 2020 by Michael Worthington; Faculty, Program in Graphic Design, Roman Jaster; Visiting Faculty, Program in Graphic Design, California Institute of the Arts, California

Course Title and Code: Google IT Automation with Python: CS1405	
Hours per Week	**Curated MOOC (approx. 6 hrs. per week)**
Credits	**4**
Students who can take	**B.Tech.**

Course Objective: This six-course certificate, developed by Google, is designed to provide IT professionals with in-demand skills -- including Python, Git, and IT automation -- that can help you advance your career. This program builds on your IT foundations to help you take your career to the next level. It's designed to teach you how to program with Python and how to use Python to automate common system administration tasks. Student will also learn to use Git and GitHub, troubleshoot and debug complex problems, and apply automation at scale by using configuration management and the Cloud.
For the four credit JKLU course, student must complete first three courses from this specialization. Motivated students are encouraged to complete the other courses also.

Learning Outcome:
On successful completion of this course, the students should be able to:

CE1401.5. Automate tasks by writing Python scripts
CE1401.6. Use Python to interact with Operating System
CE1401.7. Use Git and GitHub for version control

erequisites: Basic Computer Knowledge

aluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment (MOOC)	20
3	Class Participation	Nil
4	Quiz (MOOC)	20
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	Nil
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1 *****	30
15	Lab Evaluation2 *****	30
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Quiz	10
2	Lab Evaluation	20

*****Aligned to MOOC offered by Google.

Course Contents:

Basic Python Syntax, Loops, Strings, Lists and Dictionaries, Managing Files with Python, Regular Expressions, Managing Data and Processes, Introduction to Version Control, Using Git Locally, working with Remotes, Collaboration, Troubleshooting Concepts, Crashing Programs, Managing Resources, automating with Configuration Management, Deploying Puppet, Automation in the Cloud, Managing Cloud Instances at Scale, Manipulating Images, Interacting with Web Services, Automatic Output Generation.

Suggested Reading Materials:

BOOKS AND REFERENCES

- Lyke, H. (1999). IT Automation: The Quest for Lights Out. " Pearson".
- Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
- Halsey, M. (2016). Windows 10 Troubleshooting. “Apress”.

This course would be delivered on Coursera from July 2020 onward, offered by Google.

COURSES:

Course 1: Crash Course on Python **(18 Hours)**
Link: https://www.coursera.org/learn/neural-networks-deep-learning?specialization=deep-learning

1. **Week 1:** Hello Python!:
   1 Graded Assessment
2. **Week 2:** Basic Python Syntax:
   1 Graded Assessment
3. **Week 3:** Loops:
   1 Graded Assignment
4. **Week 4:** Strings, Lists and Dictionaries:
   1 Graded Assignment
5. **Week 5:** Object-oriented Programming (Optional)
6. **Week 6:** Final Project:
   1 Final Programming Assessment

Course 2: Using Python to interact with the operating System **(30 Hours)**
Link: https://www.coursera.org/learn/python-operating-system/home/welcome

1. **Week 1:** Getting Your Python On:
   1 Graded assessment
2. **Week 2:** Managing Files With Python:
   1 Graded Assessment
3. **Week 3:** Regular Expressions:
   1 Graded Assignment
4. **Week 4:** Managing Data and Processes:
   1 Graded Assignment
5. **Week 5:** Testing with Python
   1 Graded Assessment
6. **Week 6:** Bash Scripting:
   1 Graded Assessment
7. **Week 7:** Final Project:
   1 Final Assessment

Course 3: Introduction to Git and GitHub **(19 Hours)**
Link: https://www.coursera.org/learn/introduction-git-github/home/welcome

1. **Week 1:** Introduction to Version Control:
   1 Graded assessment
2. **Week 2:** Using Git Locally:
   1 Graded Assessment
3. **Week 3:** Working with Remotes:
   1 Graded Assignment
4. **Week 4:** Collaboration:
   1 Graded Assignment

Course 4: Troubleshooting and Debugging Techniques **(19 Hours)**
Link: https://www.coursera.org/learn/troubleshooting-debugging-techniques/home/welcome

1. **Week 1:** Troubleshooting Concepts:
   1 Graded assessment
2. **Week 2:** Slowness:
   1 Graded Assessment
3. **Week 3:** Crashing Programs:
   1 Graded Assignment
4. **Week 4:** Managing Resources:
   1 Graded Assignment

Course 5: Configuration Management and the Cloud **(17 Hours)**
Link: https://www.coursera.org/learn/configuration-management-cloud/home/welcome

1. **Week 1:** Automating with Configuration Management:
   1 Graded assessment
2. **Week 2:** Deploying Puppet:
   1 Graded Assessment
3. **Week 3:** Automation in the Cloud:
   1 Graded Assignment
4. **Week 4:** Managing Cloud Instances at Scale:
   1 Graded Assignment

Capstone: Automating Real-World Tasks with Python **(13 Hours)**
Link: https://www.coursera.org/learn/automating-real-world-tasks-python/home/welcome

1. **Week 1:** Manipulating Images:
   1 Graded assessment
2. **Week 2:** Interacting with Web Services:
   1 Graded Assessment
3. **Week 3:** Automatic Output Generation:
   1 Graded Assignment
4. **Week 4:** Putting it all Together:
   1 Final Graded Assignment

Course Title and Code: **Full Stack Web and Multiplatform Mobile App Development Specialisation CS1406**	
Hours per Week	**Curated MOOC**
Credits	**4**
Students who can take	**Under graduate (B.Tech, VII semester)**

Course Objective: With the increased usability of same online contents from varied sources there has been increasing attention paid to the various web and mobile application platforms such as android, iOS and windows. This course focuses on developing multiplatform mobile applications using the Web technologies (HTML5, CSS and JavaScript). Front-end and hybrid mobile development, with server-side support would be covered for implementing a multi-platform solution.

SKILLS YOU WILL GAIN

Learning Outcome:

On successful completion of this course, the students should be able to:

- Develop high-level plans for script solutions for mobile and web to evaluate the post-production outcome.
- Design scripts to meet given interface and media control requirements.
- Devise, carry out and evaluate functional test strategies of mobile and web design.
- Implement and evaluate techniques for the installation of cross platform mobile applications and delivery via various channels.
- Create hybrid mobile applications, using **React Native**.
- implement NoSQL databases using **MongoDB**, work within a **Node.js** environment and **Express** framework.
- Communicate to the client side through a RESTful API.

Prerequisites: HTML, Javascript, NoSQL DB, Programming Language

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	**30**
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam I	Nil
6	Theory Exam II	Nil
7	Theory Exam (End Term)	**30**
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	**30**
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil

15	Lab Evaluation2	**10**
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Theory Exam (End Term)	**30**
	Total	**30**

Course Contents:

JavaScript application development and the React library, React Router and Single Page Applications, Reactstrap, React Native UI Elements and Redux.

React Native Alerts, Animations, Gestures, and Persist Redux Store, Accessing Native Capabilities of Devices: The Expo SDK

Front-end Web UI Frameworks Overview: Bootstrap, Bootstrap CSS Components, Bootstrap JavaScript Components

Web Tools - Bootstrap JavaScript, CSS preprocessors, Less and Sass, automation using NPM scripts, and task runners like Grunt and Gulp.

Introduction to Server-side Development - Node, Node modules and the Node HTTP server, Express framework and set up a REST API using Express.

Data storage with MongoDB, the popular NoSQL database, Express generator, interaction with MongoDB from a Node application, REST API server with Express, Mongo and Mongoose, Mongoose population, secure communication using HTTPS.

Suggested Reading Materials:

Fullstack React Native: Create beautiful mobile apps with JavaScript and React Native

React Native in Action: Developing iOS and Android Apps with JavaScript

Practical React Native: Build Two Full Projects and One Full Game using React Native

This course would be delivered on Coursera from 28th July, 2020 to 29th October, 2020 by Prof. Jogesh K. Muppala, Associate Professor at Hong Kong University of Science and Technology, Faculty Fellow Student may refer course notes, videos & ppts.

This course would be delivered on Coursera from August 2020 onward, offered by **The Hong Kong University of Science and Technology**.

COURSES:

Course 1: Front-End Web UI Frameworks and Tools: Bootstrap 4 (38 Hours)

Link: https://www.coursera.org/learn/bootstrap-4/home/welcome
Course 2: **Front-End Web Development with React** (37 Hours)
Link: https://www.coursera.org/learn/front-end-react
Course 3: **Multiplatform Mobile App Development with React Native** (43 Hours)
Link: https://www.coursera.org/learn/react-native

Course 4: **Server-side Development with NodeJS, Express and MongoDB** (54 Hours)

Link: https://www.coursera.org/learn/server-side-nodejs

Course Title and Code: Applied AI CS1407	
Hours per Week	**Curated MOOC**
Credits	**4**
Students who can take	**VII Sem**

Course Objective: This course introduces AI, its applications and use cases. The course will emphasize on AI driven chatbots, use IBM Watson AI services and APIs to design, build & deploy AI-powered applications on the web.

Learning Outcome:
On successful completion of this course, the students should be able to:
1. Build and train custom image classifiers using Watson, Python and OpenCV.
2. Deploy speech enabled virtual assistants with domain intelligence to Facebook, etc.
3. Create AI chatbots and virtual assistants and deploy them on a website.
4. Create interactive computer vision web applications and deploy them on the cloud.

Prerequisites: Linear Algebra, Basic Statistics

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term) (MOOC Certification)	20
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	20
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	10
16	Course portfolio	Nil
	Total (100)	**100**

Evaluation Scheme for Retest

Sr. No	Specifications	Marks
1	Lab Evaluation2	10
2	Theory Exam (End Term)	20

Course Contents:
Introduction to Artificial Intelligence (AI): What is AI? Applications and Examples of AI, AI Concepts, Terminology and Application Areas, Issues, Concerns and Ethical Considerations, The Future with AI and AI in Action.

AI using IBM Watson: Watson AI Overview, Watson AI Services, More Watson AI Services, Watson in Action

Building AI Powered Chatbots Without Programming: Introduction, Intents, Entities, Dialog, Deployment, Context Variables & Slots, Digressions

Python for Data Science and AI: Python Basics: Types, Expressions and Variables, String Operations, Python Data Structures: Lists and Tuples, Sets, Dictionaries. Python Programming Fundamentals: Conditions and Branching, Loops, Functions, Objects and Classes. Working with Data in Python: Reading files with open, writing files with open, Loading data with Pandas, Numpy and mini project.

Building AI Applications with Watson APIs: Introduction, Watson Discovery, Building the Chatbot, Giving it a Voice

Introduction to Computer Vision with Watson and OpenCV: Introduction to Computer Vision, Image Classification with IBM Watson, Custom Classifiers with Watson Visual Recognition, Image Processing using IBM Watson and Python, Image Processing using OpenCV and Python, Project: Building a Web-Based Computer Vision App using IBM Cloud.

Suggested Reading Materials:

- https://www.coursera.org/professional-certificates/applied-artifical-intelligence-ibm-watson-ai
- IBM Skills Gateway
- https://www.edx.org/professional-certificate/ibm-applied-ai

This course is part of the **IBM Applied AI Professional Certificate Offered IBM through Coursera**. Student may refer course notes, videos & ppts.

Course Title and Code:	CS1408 – Introduction to Neo4j
Hours per Week	Curated MOOC
Credits	2
Students who can take	B.Tech. CSE

Course Objective- The aim of the course is to build knowledge of the Neo4j 4.x DBMS. Students will learn the foundational knowledge required to start building applications with Neo4j, including how to read and write data from and to the database using the Cypher language.

Learning Outcomes (Provided by IBM):
On successful completion of this course, the students should be able to:

1. Build and Query Graph Databases using Neo4j
2. Build applications using Neo4j

Prerequisites		
Sr. No	Specifications	Marks
01	Attendance	Nil
02	Assignment	20
03	Class Participation	Nil
04	Quiz	20
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III	Nil
08	Report-I	Nil
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	40
13	Project-III	Nil
14	Lab Evaluation-I	20
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	100
Evaluation Scheme for Retest		
1	Quiz	20
2	Lab Evaluation-I	20
	Total	40

Syllabus

Introduction to Graph Databases: Describe what a graph database is., Describe how to model relational data in a property graph model.
Introduction to Neo4j: Describe the Neo4j Graph Platform and its, components, Describe the features and benefits of Neo4j.
Setting Up Your Development Environment using Neo4j Sandbox, Neo4j Desktop
Introduction to Cypher: Use Match to retrieve nodes from the graph, to retrieve relationships from the graph and to retrieve properties from the graph.
Getting More Out of Queries: Use the where clause for queries, Control query processing, Control how results are returned, Work with Cypher dates and lists.
Creating Nodes and Relationships Create, update, and delete nodes and properties of nodes, Create, update, and delete relationships and properties of relationships, Merge data in the graph.
Getting More Out of Neo4j: Use parameters, Define constraints in the graph, Profile and monitor query execution, Define indexes in the graph, Import relational data into the graph.

Reference Books:

- Ian Robinson, Jim Webber & Emil Eifrem, Graph Databases, 2nd Edition, O'reily Publications

- Rik Van Bruggen, Learning Neo4j , Packt Publishers

Online Certification Course Link

https://neo4j.com/graphacademy/neo4j-certification/

Course Title and Code: Computer Communication (CS1409)	
Hours per Week	**Curated MOOC (approx. 11 Hrs. per week)**
Credits	**4**
Students who can take	**Pre-Ph.D, Post Graduate, B.Tech Under graduate (Final Year)**

Course Objectives: This course aims to provide an understanding of the fundamental concepts of computer networking, layers of protocols and network technologies.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Categorize the various type of Networks on the basis of geographical distance, topology and implementation.
2. Compare the function and services provided by different layers of OSI and TCP/IP network architectures.
3. Simulate the various Network topology in CISCO packet tracer.
4. Find out the errors in the transmitted segments through error correction and detection techniques like Checksum, Hamming Code, Cyclic Redundancy check etc.
5. Use various network monitoring commands like netstat, traceroute, ipconfig etc.
6. Analyze the underlying architectures and protocols of networking applications like File Transfers, Mail Transfers etc.
7. Apply the concepts of IP addressing, subnet masking and routing algorithms.

aluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment (Mapped with MOOC Assignment)	20
3	Class Participation	Nil
4	Quiz (Mapped with MOOC Quiz)	20
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	30
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1(mapped with MOOC project)	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1(map with MOOC programming assignment)	10
15	Lab Evaluation2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Theory Exam	30
2	Lab Evaluation	10

Course Contents:
Introduction Concepts: Goals and Applications of Networks, Network structure and

architecture, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Physical Layer Transmission Media, Switching methods.
Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols - Overview of IEEE standards. Data Link Layer - Elementary Data Link Protocols, Sliding Window protocols, Error Handling.
Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control Internetworking -TCP / IP, IP packet, IP address, IPv6.Transport Layer: Transport Layer - Design issues, connection management,
Session Layer- Design issues, remote procedure call. Presentation Layer-Design issues, Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals etc.

Suggested Reading Materials:

This course is regularly delivered on coursera by Xiabo Zhou, University of Colardo System. The specialization is divided into 4 courses with an approximate completion time of 3 months requiring a study time of 11 hours per week.

Course Title and Code: Deep Learning, CS2405	
Hours per Week	**Curated MOOC (approx. 11 Hrs. per week)**
Credits	**5**
Students who can take	**Pre-Ph.D, Post Graduate, B.Tech Under graduate (Final Year)**

Course Objective: This course includes the foundations of Deep Learning, building of neural networks, and discussion of successful machine learning projects. Students will learn about Convolutional networks, RNNs, LSTM, Adam, Dropout, BatchNorm, Xavier/He initialization, and more. Students will master not only the theory, but also see how it is applied in industry. Course includes practice of all these ideas in Python and Tensor-Flow.

Learning Outcome:
On successful completion of this course, the students should be able to:

- Identify Deep learning techniques (Convolutional networks, RNNs, LSTM, Adam, Dropout, BatchNorm, Xavier/He initialization) suitable for a given problem.
- Find creative ways to apply deep learning to solve real life problems.
- Appreciate the underlying mathematical relationships within and across Deep Learning algorithms.
- Utilize Reinforcement Learning concepts to improvise precision of models.
- Analyze Case studies from healthcare, autonomous driving, sign language reading, music generation, and natural language processing.

erequisites: Linear Algebra, Basic Statistics, Programming Language (Python), Artificial Intelligence, Machine Learning

aluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	30
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	40
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	10
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Theory Exam	30
2	Lab Evaluation	10

Course Contents:

Introduction to Deep Learning, Neural Network Basics, Shallow Neural Networks, Improving Deep Neural Networks: Hyperparameter tuning, Regularisation and Optimisation, Practical Aspects of Deep Learning, Optimisation Algorithms, Hyperparameter tuning, Batch Normalisation and Programming Frameworks, Structuring Machine Learning Projects

Foundations of Convolutional Neural Networks: Deep Convolutional Models: Case studies, Object Detection: Special Applications: Face Recognition and Neural Style Transfer, Sequence Models, Recurrent Neural Networks

Natural Language Processing and Word Embeddings, Sequence models and Attention Mechanism

Suggested Reading Materials:

This course is regularly delivered on coursera by Andrew Ng, Founding Lead of Google Brain along with instructors at DeepLearning.ai. The specialization is divided into 5 courses with an approximate completion time of 3 months requiring a study time of 11
hours per week.

<table>
<tr><td rowspan="2" colspan="2">Course code</td><td rowspan="2" colspan="3">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td colspan="2">ECE311</td><td colspan="3">Electronic Devices & Circuits</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
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<tr><td colspan="5"></td><td colspan="4"></td></tr>
<tr><td>Mid Term Test - I</td><td>Mid Term Test - II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks **</td><td>Mid Term Test - I</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks**</td></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td>30</td><td>100</td></tr>
</table>

Course Objectives:

1. To develop fundamental concepts of semiconductor device physics: concepts of Fermi Dirac statics, Energy discretization, electron-hole mobility and other important concepts
2. To help students visualize how PN Junction is formed, built-in potential, charge transport in diodes and their applications.
3. To explain the working of BJT works as amplifier and switch, different configurations of amplifier
4. To develop understanding of JFETs and MOSFETS and how they differ from BJTs
5. To develop concept of feedback and its impact on amplifier performance.

Syllabus (Theory):

Device Physics: Electrical conduction in solids, energy bands in solids, charge carriers in semiconductors, excess carriers in semiconductors.

Fabrication of p-n junctions, equilibrium conditions, forward and reverse biased junctions, metal-semiconductor junctions. Special diodes (Zener, varactor diode, solar cell, LEDs, Tunnel diode) and their applications

Electronics Devices: Bipolar junction transistors, Field effect transistors (MOSFET), DC & AC analysis of amplifiers, BJT/MOSFET as switch, High frequency performance of BJT and MOSFET. Various amplifier configurations (CE/CB/CC or CS/CG/CG) and cascading of amplifiers.

Feedback in amplifiers: Characteristics of negative feedback, Topologies. Positive feedback and oscillators.

Output Stages: Classification of Power amplifiers, Efficiency and Working principle of Class A, Class B Push pull, Class AB Pushpull, & Class C amplifiers.

Text Books:

1. Microelectronics Circuits (Theory and Applications), Adel S. Sedra and Kenneth C. Smith, Oxford International Student Edition.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson 10th Edition.
3. Solid State Electronic Devices, Ben G Streetman and Sanjay Kumar Banerjee, Pearson Education, Inc.

<table>
<tr><th rowspan="2">Course code</th><th colspan="4" rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>EE304</td><td colspan="4">Network Analysis and Synthesis</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="5"></td><td colspan="5"></td></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test - II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test - I</th><th>End Term Test</th><th colspan="2">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td colspan="2">30</td><td>100</td></tr>
</table>

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT-I

NETWORK CONCEPTS: RLC parameter, Independent and dependent sources, Voltage/current relationship for individual element, source transformation techniques, KCL, KVL for network having both Independent and dependent sources

NETWORK ANALYSIS TECHNIQUES AND THEOREMS: Superposition, Thevenin and Norton Theorem, Maximum power transfer Reciprocity theorem, Tellengen Theorem, Series and parallel resonant circuits and Q-factor, Mutual inductance, Dot Convention and duality and concept of dual network, magnetically couples circuit analysis.

UNIT-II

GRAPH THEORY AND ITS APPLICATIONS: Fundamental concepts, definitions of a graph and various related terms, paths and circuit connections, trees of a graph, cut sets and tie sets, non-separable planner and dual graphs, matrices of oriented graphs, properties and inter relationships of incidence, tie and cut set matrices, complete circuit analysis using tie set and cutest matrices

UNIT-III

AC AND DC TRANSIENTS ANALYSIS: Laplace transform fundamentals, properties and theorems, unit step function, other unit function, the impulse, ramp and doublet, Laplace transform for shift and singular, functions, initial and final value theorems, Formulation and solution of network equilibrium equations on loop and node basis, Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Time Constant, Complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations.

UNIT-IV

NETWORK FUNCTIONS: Concepts of Complex Frequency, Transform Impedance, Network functions of one and two port network, concepts of poles and zeros, properties of driving point and transfer functions, time response stability from pole zero plot.

TWO PORT NETWORKS: Voltage & current ratio of two port network, Admittance, impedance, hybrid and transmission parameter of two port networks, Conversion of one parameter to another parameter, Series, parallel and cascade connection of two port networks, Condition of reciprocity & symmetry, Iterative and Image Impedance.

UNIT-V

NETWORK SYNTHESIS: Network reliability, Hurwitz Polynomials, Positive real functions, Properties of RC, RL & LC networks, Foster and Cauer forms of RC, RL & LC networks

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
ECE489	**Analog Linear Integrated Circuits**	**3**	**0**	**2**	**0**	**5**

Course Objectives: The course aims to discuss the working of analog integrated circuits and their applications.

Learning Outcomes:

On successful completion of this course, the students should be able to:

PR1101.4. Evaluate IC parameters to choose appropriate IC's for given applications with a sensitivity to sustainability.

PR1101.5. Explain electrical characteristics of op-amps and their open loop configurations.

PR1101.6. Design inverting, noninverting, and differential amplifiers.

PR1101.7. Find out frequency response, stability, transient response, bandwidth, maximum output voltage, and other important parameters of an op-amp.

PR1101.8. Analyze and design summing and differential amplifiers, voltage to current converters, low voltage dc voltmeters, low voltage ac voltmeters, zener diode testers, light-emitting diode testers, and integrator and differentiator circuits.

PR1101.9. Design and analyze filters and oscillators viz., low-pass filters, high-pass filters, band-pass filters, band-reject filters, Butterworth filters, Chebyshev filters, Cauer filters, phase shift oscillators, Wien bridge oscillators, quadrature oscillators, square wave generators, triangular wave generators, and sawtooth wave generators.

PR1101.10. Fabricate and design some op-amp based devices such as power supplies, audio function generators, LED temperature indicators, dc motor speed controllers, appliance timers, sirens/alarms etc.

PR1101.11. Test the performance of different circuits as per IEEE, IEC, ISO and other standards.

PR1101.12. Refine the design of devices with a sensitivity to sustainability.

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Theory Exam-I	12
2	Theory Exam-II	12
3	Theory Exam-III	24
4	Class Performance	12
5	Lab Performance	24
6	Lab Evaluation	16
	Total (100)	100

Syllabus (Theory):

UNIT-I

Linear Operational Amplifiers- Differential amplifier as first stage of op-amp, Properties of ideal operational amplifier, Slew rate, CMRR.

UNIT-II

Circuits using operational amplifiers, DC and AC amplifiers, summing, scaling, and averaging amplifiers, Instrumentation amplifiers, I/V converter, V/I converter, Integrator, differentiator, differential amplifiers. Op-amp with negative feedback voltage series, voltage shunt feedback.

UNIT-II

Circuits with active elements and op-amps: Logarithmic Amplifiers, peak detection and voltage regulation.

UNIT-IV

Active Filters: First and second order Active Filters-Low pass, highpass, bandpass and band reject Filters-State Variable Filter-Switched capacitor filter, Butterworth filter design, Chebyshev Filter design.

UNIT-V

555 Timer and PLL: principle-block diagram-phase comparator-VCO-lock-in range and capture range-PLL applications. IC555 timer-functional diagram-Astable and Monostable multivibrators - Schmitt Trigger-Missing pulse detector-dual timer –Application.

Syllabus (Practical):

1. To study Op-Amp 741 characteristics and its various parameters from data sheet. 2. To study Op-amp based inverting and non-inverting amplifiers, voltage comparator and zero crossing detectors. 3. To study Op-Amp as scalar, summer and voltage follower. 4. To study Op-Amp as differentiator and integrator. 5. To design 1st order low pass and high pass active filters using Op-Amp 741. 6. To design Band Pass and Band Reject Active filters using Op-Amp 741. 7. To design Oscillators using Op-Amp (i) RC phase shift (ii) Wien bridge at 1 kHz. 8. To design (i) Astable (ii) Monostable Multivibrators using IC-555 timer. 9. To design Triangular & square wave generator using 555 timers. 10. To study operation of IC NE/SE 566 Voltage Controlled Oscillator and determine output frequency for various voltage levels. 11. To study Op-Amp based sample and hold circuit. 12. To design Schmitt trigger using op-amp.
Text Books: 1. Gayakwad, Ramakant A. Op-amps and linear integrated circuit technology. Englewood Cliffs, NJ: Prentice-Hall, 1983. 2. Roy, D. Choudhury. Linear integrated circuits. New Age International, 2003. 3. Bell, David A. "Op-amp & Linear ICs." (1997). **Reference Books:** 1. Gray, Paul R., Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer. Analysis and design of analog integrated circuits. New York: Wiley, 2010. 2. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ECE408	**Engineering Signals and Systems**	**3**	**1**	**2**	**0**	**5**

Course Objective: This course aims to provide a foundation to others dealing with signals and systems concepts: communication, control, instrumentation, etc. It covers the fundamentals of analysis, tackling both continuous and discrete time domain.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Classify signals as continuous-time vs. discrete-time, periodic vs. non-periodic, energy signal vs. power signal, odd vs. even
2. Perform basic operations in signal processing, including convolution
3. Calculate the average value, average power and total energy of basic signals
4. Write the expressions for Fourier/Z series and transform
5. Analyze the fundamental characteristics of continuous-time signals using Fourier transform
6. Analyze the fundamental characteristics of discrete-time signals using Z transform
7. Classify systems based on their properties and determine the response LTI systems
8. Identify suitable engineering standards to meet technical, safety, regulatory, societal and market needs for signal processing applications
9. Carry out case study analyses of time series data related to Sustainable Development Goals.

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	10
5	MID TERM Theory Exam	20
6	END TERM Theory Exam	30
7	Theory Exam-III	Nil
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Electronic Lab Notebook	30
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	

Course Syllabi (Theory):

Signals and Systems: Motivation and introduction to the course, basic concepts of signals and systems, signal transformations, continuous and discrete time systems, basic systems properties.

Linear time invariant (LTI) systems: Discrete and continuous – time LTI systems, convolution, properties of LTI systems, system described by differential and difference equations.

Fourier representation of periodic signals: Representation of continuous time periodic signals and their properties, representation of discrete time periodic signals and their properties, Fourier series and LTI systems, filtering.

Fourier Transform of aperiodic signals: Continuous and discrete time Fourier transform, properties of transforms, convolution and multiplication property, duality, time-frequency characterization, sampling.

Laplace and z-transform: The Laplace and z-transform, region of convergence, properties, analysis

and characterization of LTI system using Laplace and z transform.
Introduction to Sampling.

Course Syllabi (Practical):

1. Introduction to Python environment
2. Defining various variables and type conversion
3. Perform and plot basic arithmetic operation
   a. Addition, multiplication etc.
   b. Exponential, logarithmic etc.
   c. Trigonometry, complex numbers etc.
4. Working with arrays of numbers
   a. Basic mathematical operations
   b. Matrices, circles.
5. Graph Plots:
   a. Sine plots
   b. Decaying and growing functions
   c. Overlay plots
6. Use of important library functions
7. Basic 2D and 3D plots, use of subplot
8. Programs to understand creation, saving, execution of files
9. Programs involving matrices, vectors, manipulations, linear algebra.
10. Amplitude modulation and demodulation

Textbooks:

1. Oppenheim, Alan V., Alan S. Willsky, and Syed Hamid Nawab. "Signals and systems 2nd ed." *New Jersey: Prentice Hall* (1997).

Reference Books:

1. Haykin, Simon, and Barry Van Veen. *Signals and systems*. John Wiley & Sons, 2007.
2. Unpingco, José. *Python for signal processing*. Springer International Pu, 2016.

Web Resources: https://www.youtube.com/watch?v=h-CdTxDShho&list=PLC6210462711083C4

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
ECE403	**Electromagnetic Field Theory**	**3**	**1**	**0**	**0**	**4**

Course Objectives: The goal of the course is to cover the fundamental laws and concepts of electrostatics and magnetostatics. It aims to disseminate knowledge of different fields and their effect in transmission of EM waves. The course shall provide understanding of electromagnetic wave propagation in guided medium and its interaction with media.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Analyze static electromagnetic field in cables, coils, etc., used in electric power transmission circuits.
2. Analyze fluctuating electromagnetic fields in different medium, e.g., linear and isotropic medium using Maxwell's equations.
3. Analyze characteristics of EM waves under time varying potentials.
4. Analyze polarization of EM waves due to different mode of transmission.
5. Analyze time average power carried by the EM waves in the medium.
6. Analyze wave propagation through different transmission lines.
7. Analyze plane electromagnetic waves in homogeneous media.
8. Analyze the amount of electromagnetic noise generated by a device and test Electromagnetic compatibility (EMC) and electromagnetic interference (EMI).

Assessment Scheme:

Sr. No	Specifications	Marks
01	Attendance	5
02	Assignment	5
03	Class Participation	5
04	Quiz	10
05	Theory Exam	Nil
06	Theory Exam	20
07	Theory Exam	40
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	15
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation-1	Nil
15	Lab Evaluation-2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Module – 1:

Introduction: Sources and effects of electromagnetic fields, Scalar and Vector fields, Different co-ordinate systems, Gradient, Divergence and Curl, Green's and stock's theorems.

Module – 2:

Introduction to Maxwell's Equations, Faraday's Law, Transformer & Motional EMF, Displacement Current, Maxwell's Equations (differential and integral forms).

Boundary Conditions and Wave Equation: Electromagnetic Boundary Conditions, Time varying Potentials, Time harmonic fields, Time harmonics Maxwell's Equations

Module – 3:

Wave Equation & Plane Waves in unbounded homogeneous, plane waves in free space and lossy & lossless media, Skin depth, Poynting vector, Plane wave reflection and refraction, and Power considerations

Module – 4:

Polarization of Electromagnetic waves, Reflection of a plane wave at Normal incidence and Oblique incidence. Parallel & Perpendicular Polarization at perfect conducting & dielectric boundaries, Brewster's Angle.

Module – 5:

Radiation from a current element in free space, Quarter and half wave antenna, Electromagnetic interference and electromagnetic compatibility, EMI testing: emission testing, susceptibility testing, Transmission line parameters & Equations, Input Impedance, SWR and Power.

Text Book:

1. Sadiku, Matthew NO, and Shrikrishna V. Kulkarni. Principles of electromagnetics. Oxford university Press, 2015.

Reference Books:

1. Hayt Jr, William H., and John A. Buck. "Engineering Electromagnetics. Sixth Eition." McCraw + il (2001): 540-543.
2. Collin, Robert E. "Field theory of guided waves." (1960).
3. Raju, G. S. N. Electromagnetic field theory and Transmission lines. Pearson Education India, 2006.
4. "Jordane, Dward. Electromagnetic waves and radiating systems. Prentice-Hall Of Lndia Private Limited; New Delhi, 1967.

Web Link (Videos):

1. https://www.youtube.com/watch?v=pGdr9WLto4A&list=PLl6m4jcR_DbOx6s2toprJQx1MORqPa9rG
2. https://www.youtube.com/watch?v=le55C_wrb38&list=PLa8a_8vztYc4_mo4Cgt6MvIt47_HCSgS3
3. https://www.youtube.com/watch?v=0OwmYAljz4A&list=PL418163BA8A762106

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
EE1108	**Measurement and Control Systems**	3	0	2	4

Description

This course aims to provide a thorough grounding in the theoretical concepts, technologies and standards related to measurement and control systems, with an emphasis on the analysis of deterministic Linear Time Invariant (LTI) models.

Learning Outcomes

On successful completion of this course, the students should be able to:

- Select, specify, simulate and design basic measurement and control systems, emphasizing human safety, financial profitability and environmental integrity
- Assess, troubleshoot, improve and document basic measurement and control systems
- Recognize the importance of applying relevant engineering standards to meet technical, safety, regulatory, societal and market needs

Evaluation Scheme

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	MID TERM Theory Exam	10
6	END TERM Theory Exam	30
7	Theory Exam-III	Nil
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	30
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total	100

Syllabus

Theory

- **Introduction to measurement and control systems**. Definition of the elements in a control loop. Open and closed loop systems. Linear time invariant systems: Transfer function, state variable representation. Block diagram reduction techniques, signal flow graphs. Mason theorem.
- **Instrumentation**. Characteristics of instruments: accuracy, precision, sensitivity, etc. Units and standards. Voltage, current and electrical power measurements. Measurement of temperature, position, speed, force, pressure, light, level, humidity and other variables. Signal conditioning and transmission. Indicators, recorders. Actuators. Valves and motors. Instrumentation symbols. Functional identification.

- **Time response analysis**. Standard test signals, transient and steady state response, specifications, steady state error. Basic control actions. BIBO-stability, Routh-Hurwitz criterion. Basic properties of root locus.
- **Frequency response analysis**. Introduction to frequency response and specifications. Stability analysis using Bode and Nyquist plots.
- **Introduction to controller design**. PID actions, Lead-Lag compensators.

Practical

1. Introduction to control software: defining systems in TF, ZPK form and plotting response.
2. To design 1st order R-C circuits and observe its response with the following inputs: Step, Ramp, Impulse
3. To design 2nd order electrical network and study its transient response for step input and following cases: Under damped, Over damped, Critically damped system
4. To study different sensor response: temperature, position, voltage, current, capacity, etc.
5. To draw characteristics of A.C servomotor.
6. To study the Bode plot for a 2nd order system and find GM and PM. To study the frequency response of compensating networks, plot the graph and final out corner frequencies.
7. To study and design PID controllers/Lead-Lag compensators.
8. **Applications to sustainability problems**: health, energy, water, smart cities, etc.

Text Book(s)

- I J Nagrath and M Gopal. Control Systems Engineering, 3rd Ed, New Age Publication.
- N. Nise. Control System Engineering, John Wiley & Sons.
- William C. Dunn. Fundamentals of Industrial Instrumentation and Process Control, Second Edition. McGraw-Hill Education, 2018

Reference Book(s)

- K. Ogata. Modern Control Engineering, PHI Learning Pvt. Ltd., New Delhi
- B C Kuo. Modern Control Engineering, New Age Publication.
- G. F. Franklin, J. D. Powell and A. Emami-Naeini. Feedback Control of Dynamic Systems, Pearson Education Inc, 2006
- John P. Bentley. Principles of Measurement Systems. 4th Edition, Addison Wesley Longman Ltd.,UK, 2004

Web Resources

Lectures By: S. Mukhopadhyay.
https://www.youtube.com/watch?v=oxMdDsud5vg&list=PL874F91C0180417C3

Lectures By: Mrs. Gowthami Swarna
https://www.youtube.com/watch?v=XMfH2P2Fc6Q&list=PLWPirh4EWFpGpH_Rb6Q4iQ6vGGRA6MORZ&index=1
Application of measurement and control systems theory to sustainability problems: health, energy, water, smart cities, etc.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1109	Analog and Digital Communications	**3**	**0**	**2**	**0**	**4**

Course Objectives: This Course aims to develop understanding about the principle and techniques required for analog and digital communication. This will also prepare students to appraise and pursue future trends in digital communications research and technologies.

Learning Outcomes:

On successful completion of this course, the students should be able to:

- Apply the knowledge of signals and system to analyze the communication system.
- Implement and analyze various analog modulation and demodulation techniques as per ITU standards.
- Use the sampling theorem to determine optimum sampling frequency for a signal.
- Implement and analyze various digital modulation and demodulation techniques.
- Evaluate the performance of analog and digital communication systems in the presence of white noise.
- Improve receiver's performance by applying various algorithms.

Assessment Scheme:

Prerequisites		**Signal & System**
Teaching Scheme (Hours per Week)		L T P 3 0 2
Credits		4
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	10
3	Class Participation	NA
4	Quiz	10
5	Theory Exam-I	15
6	Theory Exam-II	NA
7	Theory Exam-III	20
8	Report-I	5
9	Report-II	NA
10	Report-III	NA
11	Project-I	10
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I (Continuous)	15
15	Lab Evaluation-II	15
16	Course Portfolio (partly in lieu of Quiz and Assignments)	10
	Total	100

Evaluation Scheme for Retest

1	Theory Exam-III	20
2	Lab Evaluation-II	15

	Total	35

Course Syllabi (Theory):

1. Introduction to International Standards Organization (ISO), International Telecommunications Union-Telecommunications Sector (ITU-T), Institute of Electrical and Electronics Engineering (IEEE), American National Standards Institute (ANSI) for Analog and Digital Communication
2. Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals
3. Spectral characteristics of angle modulated signals. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.
4. Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.
5. Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter Symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.
6. Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.
7. Use of Digital Communication standards & technique to develop the high data rate communication projects.

Course Syllabi (Practical):

Software

1. Introduction to MATLAB and basic signal generations and Plotting Tools in MATLAB
2. User Defined Functions, Nested If-Else, Relational Operators, Logical Operations in MATLAB
3. Matlab code for Amplitude modulation and demodulation
4. Matlab code for DSB-SC modulation and demodulation
5. Matlab code for SSB- SC modulation and demodulation
6. Matlab code for Frequency modulation and demodulation
7. Matlab code for PN sequence generation and verifying properties
8. Matlab code for BASK (OOK) Modulation and Demodulation
9. Matlab code for BFSK waveform generation and demodulation
10. Matlab code for BPSK waveform generation and demodulation
11. Matlab code to generate QPSK waveform for the given binary sequence
12. Matlab code for BER of BASK(OOK) modulation scheme under AWGN
13. Matlab code for plotting BER of BFSK under AWGN channel
14. Matlab code for BER of BPSK modulation scheme under AWGN
15. Matlab code to plot BER of QPSK under AWGN channel

References:

1. Communication Systems-B.P. Lathi, BS Publication, 2006.
2. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

4. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill,2001.
5. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering", John Wiley, 1965.
6. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
7. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

Video Lecture:

1. Analog Communication by Prof. Goutam Das, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc20_ee69/announcements?force=true#registration_confirmation
2. Digital Communication Systems by Dr. K. Vinoth Babu, VIT
   https://www.youtube.com/playlist?list=PL2ICMuWYlLBjqr9RmrQSx8zi1Q-XJOkbV
3. Principles of Communication Systems – Part I By Prof. Aditya K. Jagannatham, IIT Kanpur.
   https://www.youtube.com/watch?v=XoVLa6Dqd5I
4. Principles of Communication Systems – Part II By Prof. Aditya K. Jagannatham , IIT Kanpur.
   https://www.youtube.com/watch?v=OyWdYkx0PmI&list=PL7EYujdHIJbZ9ZRMTBmYz7i61FppXLT0p&index=1

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1115	**Digital Signal Processing**	**3**	**0**	**2**	**0**	**4**

Course Objectives: The course introduces the concepts of signals & systems, the sampling concept, representation of signals in frequency & time domain and their analyses. Introduction is also done on z transforms, fast Fourier transforms and digital filter designs. The course emphasizes on digital signal processing algorithms.

Learning Outcomes:

On successful completion of this course, the students will be able to

1.Analyze the various classifications & operations on signals

2. Analyze the frequency & time domain representations of signals

3. Implement fast Fourier transforms on signals

4. Implement discrete time systems

5. Analyze and solve problems using z transform

6. Implement digital filter design techniques

7. Implement design projects using the IEEE standards for efficient signal processing

Assessment Scheme:

Evaluation Component	**Marks**	**Modified plan (due to COVID 2019)**
Attendance	Nil	2
Assignment	10	25
Class Participation	05	3
Quiz	10	10
Theory Exam-I	20	10
Theory Exam-II	Nil	0
Theory Exam-III	20	20
Report I	5	5
Report II	Nil	Nil
Report III	Nil	Nil
Project I	10	5
Project II	Nil	Nil
Project III	Nil	Nil
Lab Evaluation I	Nil	10
Lab Evaluation II	20	10
Course Portfolio	Nil	Nil
Total (100)	100	**100**
Evaluation Scheme for Re-Test		
Theory Exam - III	20	20
Lab Evaluation - II	20	20
Total (40)	40	**40**

Syllabus (Theory):

Signals, systems and signal processing, classification of signals, Signal operations, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples.

Discrete-Time Signals and Systems (Frequency Domain analysis):
The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems; The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution; Relationship between Fourier and Z-transforms.

Efficient Computation of the DFT: Fast Fourier Transform Algorithm
Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT,Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence.

Implementation of Discrete-Time Systems:
Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures; Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

Filter Design Techniques:
Filter Function Approximations and Transformations: Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II; Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques
(Design projects using DSP standards (as per IEEE) and use of signal processing methods for efficient signal processing.)

Syllabus (LABORATORY):

11. Generation and analysis of mathematical operations/functions and analysis of continuous and discrete signal waveforms (periodic and non-periodic)
12. Generation of Exponential and Ramp signals in Continuous & Discrete domain
13. Verify the Sampling Theorem
14. Adding and subtracting two given signals. (Continuous as well as Discrete signals)
15. Analyze and compare Linear and Circular Convolution
16. To generate and analyze random sequences with arbitrary distributions, means and variances for following:
    - Rayleigh distribution
    - Normal distributions: N (0,1)
    - Gaussian distributions: N (m_x, σ_x^2)
17. Computation of DFT and IDFT using direct and FFT methods
18. Generate sum of sinusoidal signals
19. Compute frequency response of analog filters (Low Pass/High Pass)
20. To design and simulate FIR Rectangular/Hamming/Kaise windows digital filter (Low Pass/High Pass)
21. To design and simulate IIR Butterworth/Chebyshev digital filter (Low Pass/High Pass)
22. Generate Triangular and Square Waveforms using DSP Trainer Kit (TMS 320Cxxx).

Text books:

1. Digital Signal Processing Principles, Algorithms and Applications, J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.

Reference Books:

1. Digital Signal Processing: a Computer-Based Approach, Sanjit K. Mitra, TMH
2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.
3. Digital Signal Processing, Manson H. Hayes, Schaum's Outlines, TMH.
4. Digital Signal Processing: A Modern Introduction, Ashok K Ambardar, Cengage Learning.
5. Modern Digital Signal Processing, Roberto Cristi, Cengage Learning.
6. Digital Signal Processing: Fundamentals and Applications, Li Tan, Jean Jiang, Academic Press, Elsevier.
7. Digital Signal Processing: A MATLAB-Based Approach, Vinay K. Ingle and John G. Proakis, Cengage Learning.
8. Fundamentals of Digital Signal Processing using MATLAB, Robert J. Schilling and Sandra L. Harris, Cengage Learning.

Web Resources:

http://nptel.ac.in/courses

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1113	**Microwave Engineering**	**3**	**0**	**2**	**0**	**4**

Course Objectives: This course aims to provide knowledge of microwave transmission lines, waveguides, generators and amplifiers and connectors. It will help students to understand the applications of microwave devices and know the precautions while using these high frequency gadgets.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Analyze various parameters of transmission lines and measure reflection coefficient, standing wave ratio and cutoff frequency.
- Use Smith chart for finding solutions of transmission line and impedance matching problems.
- Analyze operation modes and parameters of various waveguides.
- Design & Simulate various microwave components such as waveguides, E plane TEE, H plane TEE, Magic TEE and power dividers.
- Design & Simulate a microwave/RF communication system using ITU standard frequency for a given application using appropriate components.
- Plan preventive mechanism for safety against microwave hazards in view of prescribed standards & practices.

Assessment Scheme:

Prerequisites		**Digital Communication**	
Teaching Scheme (Hours per Week)		L T P 3 0 2	
Credits		4	
Sr. No.	**Evaluation Component**	**Marks**	**Modified plan (due to COVID 2019)**
1	Attendance	NA	2
2	Assignment (programming-based ex. Python, Matlab, c)	10	13
3	Class Participation	0	0
4	Quiz	10	10
5	Theory Exam-I	15	15
6	Theory Exam-II	NA	NA
7	Theory Exam-III	25	25
8	Report-I (Case study)	10	10
9	Report-II	NA	NA
10	Report-III	NA	NA
11	Project-I	15	NIL
12	Project-II	NA	NA
13	Project-III	NA	NA
14	Lab Evaluation-I	NA	10
15	Lab Evaluation-II	15	15
16	Course Portfolio	NA	NA
	Total (100)	100	
Evaluation Scheme for Retest			
1	Theory Exam-III	25	25

2	Lab Evaluation-II	15	15
	Total (40)	40	40

Course Syllabi (Theory):

- **Transmission structures and Resonators:** RF and microwave spectrum, historical background, application of RF and microwave. Transmission Line equation, Characteristic impedance, losses in transmission line, reflection coefficient, standing wave ratio, Smith Chart, Impedance matching, Rectangular Waveguides – TE/TM mode analysis, Characteristic Equation and Cut-off Frequencies, Circular Waveguides- Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes. Cavity Resonators– Introduction, Transmission cavity, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients.
- **Microwave network theory and passive devices:** Scattering matrix -Concept of N port scattering matrix Representation-Properties of S matrix- S matrix formulation of two-port junction. Power divider, Microwave junctions -Tee junctions -Magic Tee - Rat race - Corners - bends and twists - Directional couplers -two-hole directional couplers- Ferrites - important microwave properties and applications– Termination - Gyrator- Isolator-Circulator - Attenuator
- **Microwave Generators:** Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT, Magnetrons.
- **Microwave semiconductor devices:** operation -Principles of tunnel diodes Transferred Electron Devices -Gunn diode- Avalanche Transit time devices- IMPATT and TRAPATT devices, MASER.
- **Applications of microwave:** Radar systems, Satellite Communication System, Industrial Applications

urse Syllabi (Practical):

Perform the following experiments on hardware (kits).

1. To study the basic components of Microwave Lab
2. To examine the frequency characteristics using direct reading frequency meter.
3. To calculate the frequency characteristics using formula.
4. To become familiar with the basic technique for measuring voltage standing wave ratio.
5. To study the attenuation characteristics of a variable attenuator.
6. To study I-V characteristics of Gunn Diode.
7. To measure coupling factor, directivity and insertion loss of a directional coupler.
8. To determine impedance of unknown load by measuring VSWR and the position of first field minimum.

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>EE1201</td><td>Microprocessor and Computer Architecture</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
</table>

Course Objectives: The course introduces the architectures of computers and builds the programming concepts for microprocessors. The course emphasizes on concepts on interfacing between microprocessor and peripherals, exception handling, pipelining, memory technology and hierarchy and I/O systems.

Learning Outcomes:

On successful completion of this course, the students will be able to

1. Write programs for microprocessors 8085 and 8086 using assembly language and to interface peripherals with minimum resources.

2. Determine which hardware blocks and control lines are used for specific instructions.

3. Demonstrate how to add and multiply integers and floating-point numbers using two's complement and IEEE floating point representation.

4.Implement an ALU core and analyze its timing constraints and power consumption

5. Implement memory block and memory controller. Study the timing diagram for read and write cycles for this implementation using simulator.

6. Use interrupts for special tasks on microprocessors and develop interrupt handler programs.

7. Use AXI standard for interfacing between IP core and few switches and LEDS.

8. Map a virtual address into a physical address for memory blocks**.**

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	20
6	Theory Exam-II	Nil
7	Theory Exam-III	20
8	Report I (Term paper)	10
9	Report II	Nil
10	Report III	Nil
11	Project I	15
121	Project II	Nil
13	Project III	Nil
14	Lab Evaluation I	Nil
15	Lab Evaluation II	15
16	Course Portfolio	Nil
	Total (100)	100

Syllabus (Theory):

Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit.

Instruction set architecture of 8085 and 8086: CPU - registers, addressing modes, instruction execution cycle, RTL interpretation of instructions. Familiarize with IEEE standards for Microprocessor Assembly Language.

Data representation: Signed number representation, fixed and floating-point representations, character representation. Computer Arithmetic: Review of addition/subtraction/multiplication/division, floating-point arithmetic. Programming in Embedded C.

Machine Language: Timings Diagrams, Concepts of speed and throughput

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs block size, mapping functions, replacement algorithms, write policy.

Input /Output and Communication: Disk storage, buses, I/O interfacing, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes - role of interrupts in process state transitions.

Text books:

John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, The Morgan Kaufmann Series in Computer Architecture and Design, **ISBN-10:012383872X**

Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing (India) Pvt. Ltd.

M.T. Savaliya, 8086 Programming and Advance Processor Architecture, Wiley India Pvt. Ltd.

Reference Book:

1. Shen and Lipasti, Modern processor design principles: Fundamentals of Superscalar Processors, McGraw-Hill Education**,** ***ISBN***-13: 978-1478607830.
2. Real time embedded systems: Qing Li and Carolyn Yao, SBN:1578201241

Course Title and Course Code	**Electrical System Design (EE1202)**
Hours per Week	**L T P: 3 0 2**
Credits	4
Students who can take	**B. Tech Semester-VII EE**

Course Objectives

This course aims to develop understanding about how to apply basic electrical concepts such as power factor, kVA, kW, and inductive loads, and how to design of low voltage electrical distribution systems and equipment selection according to the requirements of the National Electrical Code®. Students will do the analysis of needs and objectives, then proceed to the exploration of alternative concepts and the selection of equipment that best meet goals including performance, timeliness, and affordability.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Apply the acts in accordance with the risk and safety issues, legal obligations codes of safety practice.
2. Design the low voltage and medium voltage electrical installations and also prepare their estimates.
3. Design internal electrification and air-conditioning system for domestic, commercial and industry consumers
4. Review the design of existing electrical systems as per the standard electrical safety codes.
5. Integrate the sensors for the monitoring and automation of electrical systems.

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio (MOOC Course)	10
Total (100)		**100**

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III (End Term)	20
2	Lab Evaluation-II (Exam)	10
3	Total	30

Syllabus

Unit-I: System Planning

Basic design considerations, voltage selection, costs. General aspects of the design of electrical installations for domestic, commercial and industrial consumers, calculation of voltage drops. Preparing the cost estimate: classes of estimates, equipment and material, installation. Pre-commissioning tests of domestic installations. National Lighting Code (NIC), IS codes for lighting and interior illumination.

Unit-II: Lighting Design

Light sources, laws of illumination, interior lighting, exterior lighting, utility services, different types of loads and their individual protections, selection of cable/wire sizes, Design of illumination systems: Yard lighting, street lighting and flood lighting, design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators.

Unit-III: Internal Electrification Design

Electrical layout in residential building using Auto CAD, Selection of house wiring, sizing of conduit, switch/socket, Calculation of load on circuit, Design of sub circuit (Lighting/Power circuit), Calculation of fan, design of Earthing, Selection of low voltage switchgears, design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators.

Unit-IV: Equipment Selection

Selection and installation of transformers, Installation of induction motors, Design of automatic power factor correction (APFC) Panel, Design of indoor and outdoor 11 kV substation upto 630 kVA.

Air-conditioning systems, Size and load calculation, design of air-conditioning system for domestic/theatres, Energy conservation techniques. Pre-commissioning tests of cables, transformers and generators, Selection of UPS and Generators.

Design of Sensor Network, Substation Automation system design, Selection of PLC, Communication protocol, Substation Automation with ICE 61850 Standard, Power line carrier Equipment (PLCC).

Unit-V: Design and Engineering of Switchyard

Selection of project, Classification, Electrical clearance of substation, Insulation coordination calculation of Equipment, Outdoor substation Layout, bus-bar schemes, Sizing of Transformers, Reactive Compensation Equipment, Selection of Current/Voltage Transformers for switchyards, HT/LT Circuit Breaker, Control and Relay Panels, Protection Schemes for Substation, Lightning Protection, Selection of Insulators, Earthing of Switchyard, Cabling of Switchyard, Fire protection Facilities in Substation, DC supply/ Battery bank Sizing.

List of Experiments:

1. Survey of rural electrification and draw Single Line Diagram.
    - Visit to a village.
    - Supply is taken from pole mounted transformer and distributed in various part of village.
    - Load calculation, loading capacity of different equipments.
    - Verification of 3-phase balanced loading.
    - Finding transformer rating based on loading.
    - Making drawing sheet representing Single line diagram of three phase distribution.
2. Survey of industrial distribution system and draw Single Line Diagram.
3. Study pipe earthing and plate earthing.
4. Study of Indian standards related to design problems. (Suggestive list of Indian standards)
    I. IS 282-1982 for Hard-drawn copper conductors for overhead power transmission (second revision)

II. IS 398(Part 1):1996 for Aluminium conductors for overhead transmission purposes: Part 1 Aluminium stranded conductors (third revision)

III. IS 398(Part 2):1996 for Aluminium conductors for overhead transmission purposes: Part 2 Aluminium conductors, galvanized steel reinforced (third revision)

IV. IS 60071(Part 1):2006 for Insulation Coordination - Part 1 Definitions, principles and rules.

V. IS 3043:1987 for code of practice for earthing

VI. IS 12360:1988 for Voltage Bands for Electrical Installations Including Preferred Voltages and Frequency

VII. IS 15086(Part 5):2001 for Surge arresters: Part 5 Selection and application recommendations.

VIII. IS 3716:1978 for Application guide for insulation coordination (first revision).

IX. IS 60071(Part 1):2004 for Insulation coordination – Part 4: Computational guide to insulation co-ordination and modelling of electrical networks.

5. Survey of Cables/Conductors used in transmission and distribution system.
6. To design a proper Illumination scheme for a given working place.
7. Study of light sources: Incandescent lamps, sodium & mercury vapour lamps and Fluorescent Tube Light.
8. To study the different types of power cables and methods of laying underground cables and Localization of an earth fault by "Murray Loop Test".

References:

1. National Electric Code, Bureau of Indian Standards publications.
2. Albert Thumann, P.E., C.E.M. and Harry Franz, P.E., **"**Efficient Electrical Systems Design Handbook**"** by The Fairmont Press, Inc.
3. Xavier Roboam, "Integrated Design by Optimization of Electrical Energy Systems" published by ISTE Ltd and John Wiley & Sons, Inc.
4. Neil Sclater, John E. Traister, "Handbook of Electrical Design Details" published by TMH.
5. David J. Marne, "National Electrical Safety Code Handbook" published by McGRAW-HILL.

Online Courses:

Solar Energy and Electrical System Design

https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?productId=NxE8_I4XEeqNKQ4sLJ8qyw&productType=course&query=Electrical+System+Design&showMiniModal=true

Power System Protection https://nptel.ac.in/courses/108/105/108105167/

Course Name: Signal Processing and Machine Learning (EE1402)

This course aims at introducing the fundamentals of Machine Learning (ML) techniques which can be useful for Signal Processing (SP) applications. Although prior exposure to SP and ML is desirable, all necessary concepts will be explained.

Learning Outcomes
On successful completion of this course, the students should be able to:
1) analyze the requirements of a given SP problem.
2)design a ML model and optimize it efficiently to solve a given SP problem.

Syllabus:

1) Mathematics and signal processing refresher: linear algebra, non-linear optimization, Fourier transform and spectral analysis.
2) Machine Learning basics: Classification and Regression, Supervised and Unsupervised learning, Evaluation metrics
3) Introduction to Neural Networks, SVM and Deep Learning
4) Pipelines-Data exploration & Pre-processing, model building
5) ML tools and packages: Python, R, MATLAB
6) ML applications: Speech Recognition, Fault Prediction, Control Systems, etc.

Teaching Scheme and Credits

Hrs. per Week		Credits	Duration in Weeks
In Class	Out Class	4	
3 (L) + 0 (T) + 2(L)	2		

Course Feedback: Online - Every Fortnight
Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam I	Nil
6	Theory Exam	Nil
7	Theory Exam (End Term)	20
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	30
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	20
15	Lab Evaluation2	Nil
16	Course portfolio (MOOC)	20
	Total (100)	**100**

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam (End Term)	20
2	Lab Evaluation1	20
3	Total	40

Books:

Haykin, Simon (2008). “Neural Networks and Learning Machines”. Third Edition. McMaster University. Hamilton, Ontario, Canada. Pearson.

Rogers and Girolami (2014). A First Course in Machine Learning. CRC Press.

IT Resources

Coursera: Advanced Machine Learning and Signal Processing by IBM

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
ECE727 (Elective-III)	**RADAR & Satellite Communication**	**3**	**0**	**0**	**3**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

Course Objective: The course aims to impart knowledge on laws of science which explain extra-terrestrial communication and systems used for Radar and Satellite Communications.

Course outcomes (*after completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes)*

(A) The students will demonstrate:

1. Understanding on the primary concepts on radar and satellite communication
2. Explain how a radar detects a stationary as well as moving target.
3. Appreciate the requirements for Doppler radars, MTI, Tracking radars.
4. Explain what geostationary and geosynchronous satellites are
5. Talk with pride about the Indian scenario on satellite launch and ISRO initiatives.
6. Explain the Multiplexing techniques for satellite communication
7. Explain Telemetry, Tracking and command control system (TT&CS)

B) After successful completion, the students will be able to answer following questions:

1. What is unambiguous range in radar terminology?
2. Why modulation is required in continuous range radars?
3. What are Kepler's Laws?
4. How altitude and orbit control is done for satellites?
5. Design of satellite links for specified coordinates.

Syllabus:

Doppler effect, CW radar, FM CW radar, multiple frequency CW radar, MTI radar, delay line canceller, range gated MTI radar, blind speeds, staggered PRF, limitations to the performance of MTI radar, non-coherent MTI radar. Tracking radar: sequential lobing, conical scan, monopulse: amplitude comparison and phase comparison methods.

Radar antennas. Radar displays. Duplexer

Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, Locating the satellite with respect to the earth, sub-satellite point, look angles, mechanics of launching a synchronous satellite, Orbital effects, Indian scenario in communication satellites.

Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Space craft antennas, multiple access techniques, comparison of FDMA, TDMA, CDMA.

Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols

II. LEARNING RESOURCES:	
Textbooks	**1.** Merril. I. Skolnik, "*Introduction to radar systems*", 2/e, MGH, 1981. **2.** Timothy Pratt and Charles Bostian, "*Satellite Communications*", John Wiley, 1986.
Reference books	**1.** Toomay, *"Radar Principles of Radar"*, PHI, 2/e, 2002. 2. Dennis Roddy, "*Satellite Communications",* 3/e, MGH, 2001. 3. M. Richharia, "*Satellite Communication Systems: Design Principles*", MacMillan, 2/e, 2003
Video Lectures	Nptel: Satellite communication course by Prof KK Bandopadhyay
Websites *(related to the course)*	https://onlinecourses.nptel.ac.in/noc17_ec14/announcements?force=true#registration_confirmation
Leading industries *(related to the course)*	Indian Space Research Organization Bharat Electronics Electronics and Radar development Establishment (LRDE)

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1211	**Advanced Communication Systems**	**3**	**0**	**2**	**0**	**4**

Course Objectives: This course is focused on application of advanced communication techniques in Wireless communication, fibre optic communication and antenna design. The course also emphasizes issues of electromagnetic interference and compatibility.

Learning Outcomes:

On successful completion of this course, the students will be able to

1. Characterize fibre optic system components and classify optical fibres

2. Design optical link for specific bit error rate

3. Analyze evolution of mobile radio communications (from 2G/3G/4G systems to 5G infrastructure)

4. Design cellular system for specified handoffs and call drop probabilities

5. Analyse EMI/EMC standards and procedures

6. Characterize Antenna Radiation Hazards and implement AISG (The Antenna Interface Standards Group) standards

7. Design and analyse Planar Antenna Arrays, Microstrip Antennas and Broadband and Compact antennas

Assessment Scheme:

S. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	10
3	Class Participation	5
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	Nil
7	Theory Exam-III	30
8	Report I (Case Study)	5
9	Report II	Nil
10	Report III	Nil
11	Project I	Nil
121	Project II	Nil
13	Project III	Nil
14	Lab Evaluation I (Continuous)	10
15	Lab Evaluation II (Exam)	10
16	Course Portfolio (MOOC)	10
	Total (100)	**100**
Evaluation Scheme for Re-Test		
1	**Theory Exam - III**	30
2	**Lab Evaluation - II**	10

		Total (40)	**40**	

Syllabus (Theory):

Module 1: Optical Fiber Communication
UNIT-I: Evolution of Light wave systems, System components, Optical fibers - Step Index & Graded index - Mode theory, Dispersion in fibers, Dispersion shifted and dispersion flattened fibers - Fiber Losses - Non-linear effects, OPTICAL TRANSMITTERS/SOURCES: - LED structures - Spectral Distribution - Semiconductor lasers - Structures – Threshold conditions - SLM and STM operation - Transmitter design
UNIT-II: OPTICAL DETECTORS AND AMPLIFIERS: Basic Concepts - PIN and APD diodes structures, Photo detector Noise, Receiver design, Coherent detection Semiconductor optical amplifiers; Raman - and Brillouin amplifiers - Erbium-doped fiber amplifiers, pumping requirements, cascaded in-line amplifiers, COHERENT LIGHTWAVE SYSTEMS: Homodyne and heterodyne detectors - Modulation formats - Demodulation schemes - BER in synchronous receivers - Sensitivity degradation – Post - and pre compensation techniques - Optical solitons - Soliton based communication system
Module 2: Wireless Communication
UNIT-I: Evolution of Mobile radio communications – Mobile radio systems in the U.S. and around the world, Evolution of 1 G and 2G systems. OFDM, MIMO concepts, Evolution of 3G and 4G systems, 5G infrastructure
UNIT-II: Cellular concept – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interference and System capacity – Improving capacity in cellular systems, MOBILE RADIO PROPAGATION: Small-scale multipath propagation – Impulse response of a multipath channel – Parameters of mobile multipath channel – Types of small-scale fading – Rayleigh and Rician distributions – Statistical models for multipath fading channels
Module 3: EMI/EMC and Antenna Design
Unit I: EMI/EMC standards and procedures, Antenna design parameters, IEEE 149-1977 test procedure, Antenna Fundamentals, Antenna Radiation Hazards, Introduction to AISG (The Antenna Interface Standards Group)

Unit II: Loop Antennas, Slot Antennas, Planar Arrays, Microstrip Antennas, MSA Parametric Analysis, Broadband & Compact MSA, Tunable MSA, MSA Arrays, PIFA, Design of low power Antenna having controlled EM radiation
Syllabus (LABORATORY):

23. Characterization of Step Index and Graded Index optical fibres
24. Measurement of Numerical Aperture of optical fibres
25. Fibre Optic Analog and Digital Link establishment
26. Characterization of mobile fading channels w.r.t
    (a) Simple pathloss model
    (b) Pathloss with shadowing model
27. Characterization of Cellular Frequency Reuse
28. Characterization of Co-Channel Cells and Cell cluster
29. Characterization of Frequency Handoff
30. Design of Microstrip Patch Antennas
31. Design of Microstrip Patch Arrays
32. Characterization of EIRP and EMI/EMC certification issues w.r.t IEEE and AISG standards for radiating systems

Textbooks:

1. G. Keiser, "Optical Fiber Communication Systems", McGraw Hill, New York 2000
2. John M. Senior, “Optical Fiber Communication”, Pearson education, 3rd Edition, 2010

3. Rappaport, T.S., “Wireless Communications”, Principles and Practice, Prentice Hall, NJ, 1996
4. Constantine A. Balanis “Antenna Theory: Analysis and Design”, Wiley Student Edition, 2006

Reference Books:

1. Optical Fiber Communications– – John M. Senior, Pearson Education. 3/e, 2007
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2012
3. William Stallings, “Wireless Communication and Networking”, Pearson Education, 2002
4. John D Kraus,” Antennas for all Applications”, 3rd Edition, McGraw Hill, 2005

MOOCs:

1. **https://www.coursera.org/specializations/optical-engineering**
2. **https://www.coursera.org/learn/smart-device-mobile-emerging-technologies**
3. **https://www.coursera.org/learn/wireless-communications**
4. **https://www.coursera.org/learn/life-health-radiation**

Other Web Resources:

1. Optical fibre communication: https://nptel.ac.in/courses/117/101/117101054/
2. Wireless communication: https://nptel.ac.in/courses/117/102/117102062/
3. Antenna design: https://nptel.ac.in/courses/108/101/108101092/

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
EE1207	**Antenna Design**	3	0	2	4

Syllabus (Theory)

Standard Test Procedures for Antennas
Unit 1: Understanding the basics of Antenna Design parameters, standards and IEEE 149-1977 test procedure, Antenna Introduction, Antenna Fundamentals, Antenna Radiation Hazards, Dipole Antennas, Introduction to AISG (The Antenna Interface Standards Group).
Unit 2: Monopole Antennas, Loop Antennas, Slot Antennas, Linear Arrays, Planar Arrays
Unit 3: Microstrip Antennas (MSA), Rectangular MSA, MSA Parametric Analysis-I, Circular MSA
Unit 4: Broadband MSA, Compact MSA, Tunable MSA, Circularly Polarized MSA, MSA Arrays,
Unit 5: Helical Antennas, Horn Antennas, Yagi-Uda and Log-Periodic Antennas, Reflector Antennas, Design of low power Antenna having less EM radiation for proper transmission.
Design the basic projects using AISG (The Antenna Interface Standards Group) for sustainable development of Human and society.

Course Code and Title	**EE1209: ADVANCED CONTROL SYSTEMS**
Scheme	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech: Semester VI, EE and ECE**

Course Objective:

To develop understanding of advanced control system concepts with focus on discrete and nonlinear time invariant systems, their mathematical model formulation, stability analysis, simulation, and real-life applications and problem-solving.

Learning Outcomes:

On successful completion of this course, the students will be able to:

- CE1108.7. formulate discrete time control system problem,
- CE1108.8. design a PID and other sub-controllers,
- CE1108.9. design the compensators circuits,
- CE1108.10. assess the system performance, technical issues, and limitations,
- CE1108.11. design the state-space model for the control system and analyse its properties,
- CE1108.12. determine the stability of the discrete system using state feedback and observers,
- CE1108.13. develop programs for control problems using programmable logic controller and its software aids, and
- CE1108.14. improve a system as per design and equipment standards keeping energy efficiency in consideration.

Prerequisite: Knowledge of linear control system.

Evaluation Scheme:

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	NIL
3	Class Participation	NIL
4	Quiz	NIL
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	30
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	20
15	Lab Evaluation-II (Examination)	10
16	Course Portfolio	NIL
	Total (100)	**100**

Retest Evaluation Scheme:

1	Theory Exam-III	20
2	Lab Evaluation-II (Examination)	10
	Total (30)	**30**

COURSE SYLLABUS (Theory):

UNIT I: CLASSICAL CONTROL THEORY- PRACTICE AND LIMITATIONS

Control problem formulation. Discrete time control systems. Introduction to system identification. PID and compensators design. Performance assessment. Limits of performance. Technical issues. Standards: IEC 61131 – Industrial controllers. ISA 88 – Batch Control Systems. ISA 106 – Procedural Automation.

UNIT II: STATE SPACE ANALYSIS

Basic concepts. Linear algebra. State vector, state model, state model of linear systems, state model for Single-Input/Single-Output linear systems and linearization of the state equation. Canonical representations, transfer function for state model. Properties of the state transition matrix. Computation of state transition matrix. Controllability and observability.

UNIT III: STATE FEEDBACK AND OBSERVERS

Full-state feedback control design. Observer design. Integrated full-state feedback and observer. Reference Inputs. Introduction to optimal control problems.

UNIT IV: CASE STUDIES

Application of advanced control systems theory to sustainability problems: health, energy, water, smart cities, etc.

Syllabus (Practical)

A minimum of 8 experiments should be performed. At least 5 experiments should be from below list:

9. To study temperature control system using PID control.
10. To study flow control system using feedback control.
11. To study pressure control system using PID control.
12. Introduction of Programmable Logic Controller (PLC) and its programming software.
13. PLC programming for starting induction motor using a starter.
14. PLC programming for water level indicator.
15. PLC programming for speed control of motor.
16. Software based simulation and solution of nonlinear system problem.
17. To determine the stability of nonlinear system using Lyapunov function.
18. To find controllability and observability of a nonlinear system.

Text Book(s)

1. M Gopal, "Digital Control and State State Variable Methods- Conventional and Intelligent Control Systems", 4th Edition, McGraw Hill Education (India) Private Limited.
2. M Gopal, "Control Systems – Principles and Design", 4th Edition, McGraw Hill Education (India) Private Limited.

Reference Book(s)

1. Robert H Bishop, "Modern Control Systems" Boyd and Fraser publications.
2. Norman S Nise, "Control System Engineering" John Wiley & Sons.
3. Gene F Frankline, J David Powell, Abbas Emami Naeini, "Feedback Control of Dynamic Systems" Pearson Education Inc., 2006.
4. I J Nagrath and M Gopal, "Control Systems Engineering" 3rd edition, New Age Publication.
5. B C Kuo, "Modern Control Engineering" New Age Publication.
6. Katsuhiko Ogata, "Modern Control Engineering" PHI Learning Pvt. Ltd., New Delhi.

E-resource(s)

1. NPTEL: http://nptel.ac.in/courses/108102044/
   http://nptel.ac.in/courses/108102043/
   https://nptel.ac.in/courses/115/108/115108104/
   https://nptel.ac.in/courses/108/107/108107115/
   https://nptel.ac.in/courses/108/107/108107098/
   https://nptel.ac.in/courses/108/103/108103007/
   https://nptel.ac.in/courses/108/105/108105019/
   https://nptel.ac.in/courses/108/105/108105062/
   https://nptel.ac.in/courses/108/104/108104049/
2. NCTEL: http://www.nitttrchd.ac.in/sitenew1/nctel/electrical.php
3. SWAYAM: https://swayam.gov.in/nd1_noc20_me03/preview
   https://swayam.gov.in/nd1_noc20_ee22/preview,
   https://swayam.gov.in/nd1_noc20_me39/preview

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1208	Digital Communication Networks	**3**	**0**	**2**	**0**	**4**

Course Objectives: The course introduces the evolution of various digital communication networks. The course emphasizes on the architecture & protocols describing the wireless LANs, mobile cellular networks & optical networks. Components, applications, research issues & network management functions are discussed.

Learning Outcomes:

On successful completion of this course, the students will be able to

1. Analyze the OSI model of networks.

2. Analyze the various architectures employed in digital communication networks.

3. Analyze the different protocols used in the digital networks.

4. Design issues & protocols of wireless LANs. Emphasis on IEEE 802.11 standards. WiMax mobility support & broadband applications.

5. To formulate, solve & understand research issues in wireless networks

6. To design ad-hoc networks, sensor networks & mesh networks

7. Analyze satellite, optical and mobile cellular network architectures & protocols and their applications

8. Implement quality of service & network management functions

Assessment Scheme:

Sr. No.	Evaluation Component	Marks	Modified plan (due to COVID 2019)
1	Attendance	Nil	2
2	Assignment	10	25
3	Class Participation	05	3
4	Quiz	10	10
5	Theory Exam-I	20	10
6	Theory Exam-II	Nil	0
7	Theory Exam-III	20	20
8	Report I	5	5
9	Report II	Nil	Nil
10	Report III	Nil	Nil
11	Project I	10	5
121	Project II	Nil	Nil
13	Project III	Nil	Nil
14	Lab Evaluation I	Nil	10
15	Lab Evaluation II	20	10
16	Course Portfolio	Nil	Nil
	Total (100)	**100**	**100**
Evaluation Scheme for Re-Test:			
1	**Theory Exam - III**	20	20

	2	**Lab Evaluation - II**	20	20	
		Total (40)	**40**	**40**	

Syllabus (Theory):

1. Evolution of Communication Networks, Layered Architecture and OSI Model, Unified View of Protocols and Services
2. Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications. WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications.
3. Cellular networks, Satellite Network, Applications. Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.
4. Optical networks Client layers of the optical layer, SONET/SDH, Multiplexing, layers, Frame Structure, ATM functions, Adaptation layers, Quality of service and flow, ESCON, HIPPI, Network management functions.

Syllabus (LABORATORY):

1. NS2 Implementation of congestion control protocol (TCP over IP) after creating a duplex link using nodes in a network
2. Analyse performance of IEEE 802.4 token bus LAN protocol in MAC layer
3. Analyse performance of IEEE 802.5 token ring LAN protocol in MAC layer
4. Implement ARQ stop and wait protocol/sliding window protocol in Data Link layer of OSI model by creating a NS2 network scenario
5. Implement the different frames of HDLC protocol by creating a NS2 network scenario
6. Execute the Distance Vector Routing and Link State Algorithms
7. Analyse the performance of IEEE 802.3 CSMA/CD LAN protocol operating at MAC layer
8. Execute the go back N protocol/ selective repeat transmission flow control protocol
9. Design and Analyze a wireless sensor network architecture (also with TCP) using NS2
10. Design and Analyze a mobile ad-hoc network architecture using NS2

Text books:

1. “Optical Network Design and Planning”, Simmons, Jane M, Springer.
2. “Computer Networks”, Andrew S. Tanenbaum, David J. Wetherall, Pearson, 2013.
3. Tse, David, and Pramod Viswanath. Fundamentals of wireless communication. Cambridge university press, 2005.

Reference Books:

1. Data and Computer Communications, William Stallings, 8/e
2. Data Communication and Networking, Behrouz Forouzan, 5/e

Web Resources:

http://nptel.ac.in/courses

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
EE1206	Industrial Drive and E-Vehicle	3	0	2	4

Course Objectives: This course is aimed at developing the required understanding to design various control strategies for AC & DC machines and select proper size & type of motor as per industry requirements. It focuses to develop power electronics applications for electrical machines and industrial equipment.

Prerequisites: Electrical Machines and Industrial Electronics.

Learning Outcomes

On successful completion of this course, the student will able to:

1. Apply the theories of electrical machines, power electronic converters and control system design to implement electric drive systems and analyze transient behaviour of electric drives.
2. Design BJT, MOSFET and IGBT gate drive circuits, protection circuits as well as cooling requirements for power semiconductor devices.
3. Implement the control techniques in DC to AC or AC to DC converters for efficient starting, braking and speed control operation of electric motors.
4. Analyze square wave, PWM single phase and three phase voltage source inverters for output voltage amplitude and frequency control to drive AC motors.
5. Use 3002.7-2018 - IEEE standards for minimizing transient losses and starting time.
6. Select suitable battery storage for E-Vehicles with sensitivity to possible environment impacts.
7. Specify the required motor rating for different type of E-Vehicles to operate in different conditions.
8. Utilize Matlab as simulation tool to accurately analyze the electric drive system

Syllabus (Theory)

INTRODUCTION: - Definition & classification of different type of drives, Dynamics of electrical drives, Review of characteristics and components of electric drives, acceleration and retardation time, energy consideration.

BRAKING and SPEED CONTROL OF DRIVES:- Various methods of braking of a.c. and d.c drives, Automatic control arrangement, Speed control methods of various a.c. and d.c. drives, its advantages and applications , Transient analysis.

INDUCTION MOTOR (A.C) DRIVES: - Basic principle of induction motor drives, 3 Ø a.c voltage controller fed I.M drive, variable frequency control, voltage source inverter (VSI) and current source inverter (CSI), cycloconverter fed IM drive, Slip Power control, static rotor resistance control, chopper control of 3 -Ø slip ring induction motor.

DC DRIVES: - Rectifier controlled circuits, Single phase fully controlled and half controlled rectifier fed separately excited d.c motor, 3Ø fully and half controlled fed separately excited d.c. multiquadrant operation of dc separately excited motor, Motor, performance and characteristics, Control techniques of d.c. Drives using chopper.

ELECTRICAL VEHICLES: - Concept of electrical vehicles, Hybrid electrical vehicle, plug-in electrical vehicle, battery electrical vehicle., choice of motors for EVs, storage technology, Grid integration of EVs, Sensors for EVs, Introduction of tesla car.

Syllabus (Practical)

1. Three phase voltage source inverter simulation using MATLAB
2. Three phase voltage source converter with space vector PWM simulation using MATLAB.
3. Buck converter simulation using MATLAB.
4. Boost converter simulation using MATLAB.
5. Speed control DC Motor using BJT-H bridge simulation using MATLAB
6. Three phase thyristor converter simulation using MATLAB
7. Chopper fed DC motor drive simulation using MATLAB
8. Three phase permanent magnet synchronous motor drive simulation using MATLAB

Course Assessment:

Prerequisites		Transmission and Distribution
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	Nil
2	Assignment	15
3	Class Participation	05
4	Quiz	15
5	Theory Exam-I	10
6	Theory Exam-II	Nil
7	Theory Exam-III	20
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	15
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (End term Exam)	10
16	Course Portfolio (MOOC Course: converter circuits) (optional with Liu of assignment and quiz)	10
	Total (100)	
Retest		
17	Theory Exam-III	20
18	Lab Evaluation-II (End term Exam)	10
	Total (30)	30

Text / Reference Books:

1. G.K.Dubey,” Fundamentals of Electric Drive”. Narosa Publishing House.
2. Bimbhra.P.S. “Power Electronics” Khanna Publisher.
3. Singh M.D. & Khanchandani K.B. “Power Electronics” Tata McGraw Hill
4. Sen P.C. “Power Electronics”, Tata McGraw Hill
5. Chau K.T. “Electrical Vehicle Machines and Drives Design, Analysis and Application”, Willey, IEEE Press.
6. M. Ramamurthy: An Introduction to Thyristors and their Applications, East West Press Pvt Ltd.

7. Mohammad H. Rashid: Power Electronics Circuits, Devices and Applications, Prentice Hall of India Pvt Ltd.
8. Seth Leitman Bob Brant: Build Your Own Electrical Vehicle, Tata McGraw Hill.

MOOC Course

Introduction to Power Electronics (Coursera)

https://www.coursera.org/learn/power-electronics

Converter Circuits (Coursera)

https://www.coursera.org/learn/converter-circuits

NPTL Lectures

https://nptel.ac.in/courses/108/108/108108077/

https://nptel.ac.in/courses/108/104/108104140/

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>EE484</td><td>Electrical Machines-I</td><td>3</td><td>1</td><td>2</td><td>0</td><td>4</td></tr>
</table>

Course Outcomes:

1. Equip students with the knowledge for electromechanical energy transformation process for transformers and DC machines.
2. Provide the essential numerical background for analyze performance of DC machines and transformers.
3. Develop students' skills to design transformer and DC machine.

Learning Outcomes:

On successful completion of this course, the students should be able to

1. Analyze the Electromechanical energy transformation principle, laws and design magnetic systems.
2. Use mathematical models to analyze the working of transformers and DC machines under loaded and unloaded conditions.
3. Analyze and evaluate performance of single-phase transformers and auto transformers.
4. Troubleshoot the operation of electrical machines and evaluate suitable measures for associated problems.
5. Convert 3 phase transformers into 2 phase transformers.
6. Evaluate and choose appropriate 3 phase transformer for given applications.
7. Analyze the characteristics of various types of DC generators and motors. Also choose appropriate DC generators and motors for given applications as per IEC/BIS standards.
8. Test DC motors as per IEC/BIS standard.
9. Design low voltage single phase transformers.

Assessment Scheme:

Prerequisites		Elements of Electrical Engineering
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment	5
3	Class Participation	5
4	Quiz	NIL
5	Theory Exam-I	NIL
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	20
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
	Total (100)	100

Syllabus (Theory)

UNIT I: Principles of electromechanical energy conversions: Introduction, Flow of Energy in Electromechanical devices, Energy in Magnetic Systems, Singly Excited System, Determination of Mechanical Force, Mechanical Energy, Torque Equation, Doubly Excited System, energy stored in magnetic field, Electromagnetic Torque, Generated EMF in Machines, Torque in Machines with Cylindrical air-gap.

UNIT II: Transformer: Types, Working principle, Construction, EMF equation, Phasor diagrams, Equivalent circuits, losses, Efficiency and Voltage regulation, All Day Efficiency, O.C./S.C. Test, Sumpner Test, Polarity Test, Parallel Operation and load sharing.

Auto transformer: Single phase and Three Phase Auto-Transformer, VI relation, Regulation and Efficiency, advantages and disadvantages over two winding transformer, applications of auto transformer.

Three phase transformer: Construction, Phase Groups, Connections (including open delta), Parallel Operation and load sharing, magnetizing Inrush, harmonics in transformer, Three Winding Transformer. IEC60616 /IEC60076 standards,

UNIT III: DC generator: Construction, Armature Winding, Equalizer connections, Dummy coils, EMF and Torque Equation, Armature reaction, Demagnetizing and Cross Magnetizing Effects, Commutation, Methods for Improving Commutation, Inter poles and Compensating winding, Performance Characteristics of dc generators, Parallel operation. NEC standards

UNIT IV: DC motor: Performance characteristics of DC Motors, speed control of DC motors, Direct-Current Motors construction, Operation of a DC Motor, Starting of DC motor, 3 point and 4 point starters, Speed Regulation, Losses in a DC Motor, Series Motor, Shunt Motor, The Compound Motor, Methods of Speed Control, Efficiency and Testing of dc Machines -Brake Test, Swinburne Test, Hopkinson's Test, Field Test, Retardation Test. NEMA MG 1-2016 standard for motor and generator

Syllabus (Practical)

1. Speed control of D.C. shunt motor by (a) Field current control method & plot the curve for speed vs. field current. (b) Armature voltage control method & plot the curve for speed vs armature voltage.
2. Speed control of a D.C. Motor by Ward Leonard method and to plot the curve for speed vs applied armature voltage
3. To determine the efficiency of D.C. Shunt motor by loss summation (Swinburne's) method.
4. To determine the efficiency of two identical D.C. Machine by Hopkinson's regenerative test.
5. To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.
6. To perform back-to-back test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit.
7. To perform parallel operation of two 1-phase transformers and determine their load sharing.
8. To determine the efficiency and voltage regulation of a single-phase transformer by direct loading.
9. To study the performance of 3-phase transformer for its various connections, i.e. star/star star/delta delta/star and delta/delta and find the magnitude of 3rd harmonic current.
10 To perform parallel operation of two 3-phase transformers and determine their load sharing.

Main References

1. Nagrath I.J.and Kothari D.P, "Basic Electrical Engineering" TMH, Third Edition 2011.
2. B. L. Theraja, "A Text Book on Electrical Technology" S.Chand, VolumeII. 2012.
3. Electric Machinery and Transformers-Bhag S. Guru,Huseyin R. Hiziroglu-Oxford Publication.
4. Electrical Engineering - Principles and Applications, Allan R. Hambley, PHI, fourth edition- 2007.
5. Electrical Machines by P S Bhimbra- Khanna Publishers.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE303	Measurement & Instrumentation	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	Mid Term Test – II	End Term Test	Class Participation/ Additional Continuous Evaluation	Total Marks**	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation	Total Marks**
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others
**The ratio of weightage between Theory and Practical content will be 60%: 40%

Course Syllabi (Theory):

UNIT I Introduction of Measurements and Theory of Error: Functional elements of an instrument, Static and dynamic characteristics, Errors in measurement, Statistical evaluation of measurement data – Standards and calibration. Analog Measurement of Electrical Quantities: PMMC, MI, Electro dynamic, Thermal, Electrostatic & Rectifier type instruments, Electro dynamic Wattmeter, errors & remedies in wattmeter and Energy meter. Instrument Transformers.
UNIT II Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, A/D and D/A converters, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.
Resistance Measurement: Measurement of Low Resistance by Kelvin’s Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Earth Resistance.
UNIT III AC Bridges: Sources and detectors, Generalized treatment of four-arm AC bridges, Maxwell's bridge, Hay's bridge and Anderson bridge, De-Sauty Bridge and Wien's bridge. Sources of error in bridges and precautions.
UNIT IV POTENTIOMETER: Construction, Theory and Principle of operation of DC Potentiometers and AC Potentiometers, Calibration of Ammeter, Voltmeter and wattmeter, Volt-ratio box.
UNIT V Transducers: Definition, Classification, Selection Criteria, Principle, Strain Gauge, Thermistor, RTD, Piezoelectric, Thermocouple, LVDT, Application of transducers.

Course Syllabi (Practical):

1. Measurement of resistance by kelvin’s double bridge.
2. To study Anderson Bridge.
3. To Study Wien’s Bridge.
4. To study Maxwell's Capacitance & Inductance Bridge.
5. To study Solar Energy Trainer with built in Voltmeter & Ammeter.
6. To study Ultrasonic transducer Trainer
7. Displacement measurement using LVDT
8. Temperature measurement using RTD, Thermocouple.
9. Calibration of single-phase energy meter using phantom loading.
10. Calibration of ammeter/voltmeter using potentiometer.
11. Measurement of earth resistance by fall of potential method.

Text Books:

1. Cooper &Helfrick, “Modern Electronic Instrumentation and Measurement Techniques”, PHI.
2. A. K. Sawhney, “A Course in Electrical and Electronics Measurements and Instrumentation”, Dhanpat Rai & Sons

Reference Books:

1. H. S. Kalsi, “Electronic Instrumentation”, TMH.
2. Thomas and Clark, “Handbook of Electronic Instruments and Measurement Techniques”, PHI.

Course code	Course Title	Teaching Scheme				
		L	**T**	**P**	**S**	**Credits**
EE1106	**Control System**	**3**	**0**	**2**	**0**	**4**

Syllabus (Theory):

UNIT I: INTRODUCTION TO CONTROL SYSTEM: Open loop and closed loop systems, examples, components of control systems, types of control systems, concept of feedback, positive and negative feedback.

UNIT II: MATHEMATICAL MODELING OF PHYSICAL SYSTEMS

Modeling of physical systems such as mechanical, electrical, thermal and chemical systems, analogous systems, concept of transfer function, poles, zeros, order and type of the system, computation of overall transfer function, block diagram reduction techniques, signal flow graphs.

UNIT III: TIME RESPONSE ANALYSIS: Standard test signals, transient and steady state response of first and second order systems, time response specifications, types of systems, steady state error and error constants. Basic control action and automatic controllers, Effect of PI, PD and PID controllers on system performance.

UNIT IV: STABILITY ANALYSIS OF CONTROL SYSTEMS: Notations of stability, Necessary conditions for stability, Routh-Hurwitz stability criterion, Relative stability, Basic properties of root locus, rules to construct root locus, stability analysis using root locus. ISO 15746.

UNIT V FREQUENCY DOMAIN ANALYSIS: Introduction to frequency response, frequency domain specifications, stability analysis using Bode plots, stability analysis using Polar and Nyquist plots.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1103	**Advanced Electrical Machines**	**3**	**0**	**2**	**0**	**4**

Syllabus (Theory)

Polyphase AC Machines: Construction and performance of double cage and deep bar three-phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, starting and speed control method, EEMUA132 standards.
Windmill Generator: Characteristics of wind power. Wind power parameters, Classification of windmill generators, Configuration of variable slip wind turbine generator and Doubly Fed Induction Generator. IEC 61400 I standards
Single phase Induction Motors: Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors. IEEE81 standards
Synchronous machines: Construction, Operating characteristics of synchronous machines, V-curves, salient pole machine–two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators, swing equation of a single machine connected to the infinite bus and its stability considerations
Special purpose machine: Two-phase ac servomotors, Stepper Motors, Switched Reluctance Motors and repulsion motors.

Syllabus (Practical)

1. To perform OC & SC test on a three-phase transformer & find its efficiency and parameters for its equivalent circuit.
2. To perform sumpner’s back-to-back test on 3 phase transformers, find its efficiency & Parameters for its equivalent circuits.
3. Separation of iron losses of Single- phase transformer.
4. To perform no load and blocked rotor test on a 3-phase induction motor and to determine the parameters of its equivalent circuits. Draw the circle diagram and compute the following (a) Max. Torque (b) Current (c) slip (d) p.f. (f) Efficiency.
5. To perform the load test on a 3-phase induction motor and determine its performance characteristics (a) Speed vs load curve (b) p.f. vs load curve (c) Efficiency vs load curve (d) Speed vs torque curve.
6. To plot OCC & SCC of an Alternator and to determine its regulation by synchronous impedance method.
7. To find Xd and Xq of a salient pole synchronous machine by slip test.
8. To plot the V-curve for a synchronous motor at 100 % Load, 75 % Load, 5o % Load and at No-Load.

Course code	Course Title	Teaching Scheme			
		L	T	P	Credits
EE1107	**Power System-I**	**3**	0	**2**	**4**

Course Description

This course is designed to give students the ability to install, maintain and troubleshoot various types of electric power generation, transmission and distribution systems. The students will learn how generators operate and how power is transmitted via transmission / distribution lines. The course will also focus on the environmental impacts from power generations and will look at alternative and sustainable generation systems.

Learning Outcomes

On successful completion of this course, the students should be able to:

1. Evaluate the options of energy generation through conventional and renewable energy sources.
2. Analyse general layout, major equipments and auxiliaries in various types of power stations
3. Apply power system concepts required to design engineering systems.
4. Design power system components for a specified system and application
5. Formulate A.C and D.C supply systems for transmission and distribution of electrical power
6. Analyse the performance of transmission lines
7. Analyse the environmental impact of electrical energy generation from coal based thermal power plants.

Course Evaluation for Power Systems-I:

Prerequisites		Basics of Electrical Engineering,
Teaching Scheme (Hours per Week)		L T P (3 0 2)
Credits		04 Credits
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	-
2	Assignment	10
3	Class Participation	05
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	-
7	Theory Exam-III	30
8	Report-I (case study)	10
9	Report-II	-
10	Report-III	-
11	Project-I	-
12	Project-II	-
13	Project-III	-
14	Lab Evaluation-I	10
15	Lab Evaluation-II	15

16	Course Portfolio	-
	Total (100)	100

Syllabus (Theory):

Unit-I: Generation of Electrical Power
Hydro-electric, Thermal steam power plants, Nuclear power plants – selection of site, elements of power plant, working and classification, Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, micro-hydro power plants, fuel cells and diesel and gas power plants.

Unit –II: Tariff and Economic aspects in power Generation
Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, Tariffs.

Unit-III: Supply System
Structure of electric power system, Types of AC and DC distributors, distributed and concentrated loads, Distribution systems, feeder and distributor, radial, loop & grid system, primary feeder conductor size, Kelvin's law. Computation of voltage drop, Transmission & distribution losses.

Unit-IV: Overhead Transmission Line
Types of conductors, Conductor materials, Line supports, Insulators, String efficiency, Sag, Calculation of line parameters – Inductance and Capacitance of single phase, three phase, symmetrical and unsymmetrical configurations, Concepts of GMD and GMR, Transposition, Bundle conductors, Double or parallel circuit, Effect of earth on capacitance calculation, Interference with communication circuit, Concept of Corona discharge.

Unit-V: (a) Performance of Lines
Short, medium and long lines - Representation, A, B, C, D constants, Voltage regulation and Transmission efficiency, Ferranti effect, Effect of active and reactive power flow on bus voltage magnitude and phase angle.

(b) Underground Cables
Types of cables, cable components, capacitance of single core and 3-core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.

Syllabus (Practical)

11. Measurement of solar irradiance Intensity and Study of solar energy trainer and solar panel.
12. Calculation of power and load for solar photo-voltaic system.
13. Study of solar battery charger with MPPT technique.
14. Modeling and simulation of solar PV module.
15. Study of wind training system.
16. Study of bio-energy training system.
17. Study of fuel cell trainer.
18. Modeling and simulation of hybrid energy system (to be performed in Lab and MATLAB/ HOMER environment).
19. Modeling and simulation grid connected hybrid energy system (to be performed in Lab and MATLAB/ HOMER environment).
20. To Design the distribution network and measurement of voltage and current in distributors.
21. To Study of different types of a power cable and measurement of insulation resistance.
22. To observe and compensate Ferranti effect in a Long Transmission Line

Text Book(s)

5. Generation of Electrical Energy by B.R. Gupta, S. Chand Publications.
6. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers.
7. Power System Analysis & Design by B R Gupta, S Chand Publications.

8. Power System Engineering by I. J. Nagrath & D. P. Kothari, TMH publication
9. Electrical Power Transmission and Distribution by Sivanagaraju and Satyanarayana, Pearson Education.

Reference Book(s)

1. B. H. Khan," Non-conventional Energy Resources" TMH.
2. Soni, Gupta, Bhatnagar "Electrical Power System." Dhanpat Rai & Sons.
3. Electrical Power System by C. L. Wadhwa, New Age International publisher.

Course Title and Course Code	**Power System-II (EE 1114)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI EEE**

Course Objective: The course focuses on representation of power system using per unit system and study fault analysis, formation impedance and admittance matrices for power system network, finding different electrical parameters for various buses in power system, assessment of steady state and transient stability of power system.

Learning Outcomes:
On successful completion of this course, the students will be able to:

1. Develop the computational models for Power system analysis including per unit system and stability.
2. Analyze the performance of power system under symmetrical and unsymmetrical fault conditions.
3. Evaluate the model of power system components during normal and fault conditions.
4. Evaluate the power system dynamics and its stability during normal and abnormal conditions according to IEEE standards.
5. Assess the different methods of control and compensation to choose the best option so that social and environmental problems are minimized and recognize the need to continuously follow the advancements in technology and incorporate them in the present system to improve efficiency and increase the flexibility and quality of operation.

Sr. No	Specifications	Marks (Existing)
1	Attendance	NIL
2	Assignment	10
3	Class Participation	05
4	Quiz	05
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I (case study)	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio	10
	Total (100)	**100**

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III (End Term)	30
2	Lab Evaluation-II (Exam)	10
3	**Total**	**40**

Syllabus (Theory)

UNIT-I: Per Unit System: Per unit quantities, Impedance/Reactance diagram of a balanced for a balanced 3-phase system, per unit impedance of 3-phase transformer, **Admittance Model**: Equivalent admittance network and calculation of Y bus, Modification of an existing Y bus.

UNIT-II: Symmetrical Fault Analysis: Transient analysis of a transmission line, Short circuit analysis of a synchronous machine, Equivalent circuits of synchronous machine under sub transient, transient and steady state conditions, Fault analysis of an unloaded and loaded synchronous generator, balanced three phase fault analysis, Selection of circuit breaker.

UNIT-III: Sequence Components: Fortesque theorem, symmetrical components, Sequence networks of transmission lines, Synchronous machine and Transformers, sequence networks of power system, Phase shift in star-delta transformers. **Unsymmetrical Fault Analysis:** Classification of unsymmetrical faults, analysis of Unsymmetrical faults i.e., L-G, L-L, L-L-G faults, connection of sequence networks under the fault conditions, IEC 60909, ANSI/IEEE Short Circuit Studies standards**.**

UNIT-IV: Power System Stability: Steady state stability, transient stability, Power angle curve, equal area criterion, swing equation, Methods of improving stability, High speed fault clearing, regulated shunt compensation, dynamic braking, and Independent pole operation of circuit breaker, automatic voltage regulator.

UNIT-V: Load Flow Study: Load flow problem, development of load flow equations, bus classification. Gauss Seidel, Newton-Raphson, decoupled and fast decoupled methods for load flow analysis. Comparison of load flow methods, IEEE30022018-1721251 load flow standard.

Syllabus (Practical)

1. Introduction to Matlab and its commands.
2. Matlab program to solve swing equation using point by point method.
3. Matlab program to find optimum loading of generators neglecting transmission loses.
4. Matlab program to simulate Ferranti effect.
5. Matlab program for formulation of admittance matrix.
6. Matlab program to solve load flow equations by Gauss Seidel method.
7. Matlab program to solve load flow equation by Newton Raphson method.
8. Matlab program for formulation of impedance matrix.
9. Modelling of DC Machines.
10. Modelling of Synchronous Machine.
11. Modelling of Induction Machine.

Textbooks

1. Kothari. D. P., Nagrath. I. J., "Power System Engineering", TMH New Delhi, 2019.
2. Gupta, B.R., "Power System Analysis and Design", S. Chand & Company Ltd. New Delhi, 2015.
3. Hadi Saadat, "Power System Analysis", TMH New Delhi, 2011.

Reference books

1. Weedy B.M., Cory B.J., Jenkins **N., Ekanayake J.B., Strbac G., "Electric** Power Systems", John Wiley & Sons Limited, 2012.
2. Wadhwa C. L., "Electrical Power Systems", New Age International Private Limited, New Delhi, 2017.
3. Glover J.D., Sarma M., Overbye T. J., Power System Analysis & Design, Cengage Learning India Private Limited, 2012.
4. Grainger John, William Stevenson Jr., Power System Analysis, Hill Education, 2017.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE602	Switchgear & Protection (Curated MOOC-Swayam Online Course on Power System Protection and Switchgear)	**0**	**0**	**0**	**3**	**4**

Course Objectives:
The course aims to understand role of protection system for electrical power system. It gives a comprehensive knowledge for protection of transformers, bus bars, overhead, alternator and underground feeders. In continuation, it provides a summary along with examples of real-life engineering applications to a variety of technical problems.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Identify and interpret the type of risks faced by power systems. Importance of fault detection and its remedial action like tripping of faulty apparatus to minimize damage as well as provide safety to the human life.

- Analyze the construction, characteristics and application of various types of circuit breakers. Also identify and provide solutions to complex problems associated with circuit breakers

- Analyze the construction, characteristics and application of various types of relay. Also identify and ability to manage projects linked with power system protection using static relays

- Ability to design a protection monitoring for generators, transformer, bus bar and motors.

Assessment Scheme:

Prerequisites	Fundamentals of Power System
Teaching Scheme (Hours per Week)	NPTEL, Swayam Online Course on Power System Protection and Switchgear Indian Institute of Technology Roorkee
Credits	4

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	30
5	Theory Exam-1	Nil
6	Theory Exam-2	30
7	Theory Exam-3	40
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project-1	Nil
12	Project-2	Nil

13	Project-3	Nil
14	Lab Evaluation-1(Continuous)	Nil
15	Lab Evaluation-2	Nil
16	Course portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-3	40

Course Syllabi (Theory): Fundamentals of Protective Relaying , Current based Relaying Scheme, Protection of Transmission Lines using Distance Relays, Carrier Aided Schemes for Transmission Lines and Auto-reclosing and Synchronizing, Protection of Generators, Transformers, Induction Motors and Bus bars, Protection against Transients and Surges along with System Response to Severe Upsets, Arc Interruption Theory in Circuit Breaker, Types of Circuit Breakers and their Testing, Testing, Commissioning and Maintenance of Relays.

Text Book(s)/ Reference Book(s)/E-Content Link

1. Coursera material on Power System Protection and Switchgear, available on https://onlinecourses.nptel.ac.in/noc20_ee80/preview
2. Electrical Power System by C.L. Wadhwa, New age international publisher.
3. Anderson, P.M., Power System Protection, IEEE Press, New York, 1999.
4. Blackburn, J.L., Applied Protective Relaying, Westinghouse Electric Corporation, New York, 1982.
5. Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd edition, New Delhi, India, 2018.
6. Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, Tata McGraw Hill, New Delhi, 2010.
7. Phadke, A.G. and J.S. Thorp, Computer Relaying for Power Systems, Research Study Press Ltd, John Wiley & Sons, Taunton, UK, 1988.

Course Title and Course Code	**Advances in Power Delivery (EE1213)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII EE**

Course Objectives: The course focuses on the concepts of distribution automation, extra high voltage AC/DC transmission. it also emphasis on the behavior of the line parameters, the effect of corona, electrostatic field calculations, FACTs devices and protection schemes.

Learning Outcomes:
On successful completion of this course, the students will be able to:

1. Design and evaluate the distribution system for a given geographical service area and Assess the role of automation in Distribution system.
2. Identify and calculate the various parameters of EHV line for modeling.
3. Identify and analyze converter configurations used in HVDC and list the performance metrics.
4. Identify configuration of FACTS controller required for a given application
5. Realize the various dynamic characteristics for protection of transmission lines, transformers.
6. Assess the different methods of control and compensation to choose the best option so that social and environmental problems are minimized as per the IEEE standards.

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	10
3	Class Participation	05
4	Quiz	05
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio (MOOC Course)	10
Total (100)		**100**

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III (End Term)	20
2	Lab Evaluation-II (Exam)	10
3	**Total**	**30**

Syllabus (Theory)

UNIT I: Distribution System & Automation

Distribution of power, future distribution systems, load forecasting, Distribution System Topology and Structure, Distribution Automation (DA) and Control, DA Function, Distribution Management Systems, Voltage/VAr Control, Reconfiguration of Distribution Systems, Intelligent Systems in DA, AMI/AMR, Utility Communication Architecture, earthing and grounding.

UNIT II: EHV AC transmission

Engineering Aspects of EHV AC Transmission System: Principles, configuration, special features of high voltage AC lines, power transfer ability, reactive power compensation, audible noise, corona, bundle conductors, electric field, right of way, tower configuration, Principles of radio interference, origin of radio interference, method of propagation, factors to be considered in line design.

UNIT III: HVDC transmission

HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission, Basic scheme and equipment of converter station, Ground return, Basic principles of DC link control and basic converter control characteristics, multi-terminal HVDC systems, HVDC circuit breaker, Application of HVDC transmission.

UNIT IV: FACTs

Introduction to FACTs controllers, types of FACTs controllers, Brief description of STATCOM, Thyristor controlled series capacitors and unified power flow controller, Shunt capacitors and reactors, saturable reactors, Thyristorised static VAR compensators- TCR, FC-TCR and TSC- TCR, UPFC and IPFC.

Unit-V: Protection Schemes

Overcurrent and overvoltage protection of transmission lines, differential protection, transformer protection, generator protection, induction motor protection, Bus bar protection, distance protection scheme, carrier aided protection of transmission lines, Insulation coordination calculation of equipment.

List of Experiments:

1. Calculation of ABCD Parameters for Short, Medium and Long Transmission Lines.
2. Study of shunt Var compensation at different points of transmission network and observe the bus voltage.
3. Power quality improvement of a transmission line using FACTs
4. Reactive power compensation of a transmission line using STATCOM
5. Modeling of FACTS devices using MATLAB.
6. Optimal location of FACTS controllers
7. Study under/over frequency relay and check it's setting experimentally.
8. To study the directional over-current relay in virtual lab environment.
9. To find out dielectric strength of transformer oil in virtual lab environment.

Text Books:

1. A S Pabla, "Electric Power Distribution", TMH
2. B R Gupta, "Power System Analysis & Design" S. Chand Publishers
3. Nagrath Kothari, "Modern Power System Analysis", TMH
4. R. D. Begamudre, "EHV AC. Transmission Engineering" Wiley Easter Ltd. New Delhi.
5. K. R. Padiyar,"HVDC Power Transmission Systems", New Age International.
6. Badari Ram, D.N Viswakarma, "Power System Protection and Switchgear" by TMH Publications.
7. Sunil S Rao, "Switchgear and Protection" by Khanna Publishers.

Reference Books:

1. J. J. Grainger & W. D. Stevenson, "Power System Analysis", TMH.
2. P. Kundur," Power System Stability & Control", TMH.
3. H.V.D.C. Transmission – P.Kundur, TMH.
4. B Ravindranath and M Chander, "Power System Protection and Switchgear" TMH

Online Courses:

Introduction to Smart Grid
https://nptel.ac.in/courses/108/107/108107113/
DC Microgrid
https://nptel.ac.in/courses/108/107/108107143/
FACTs Devices
https://nptel.ac.in/courses/108/107/108107114/

Power System Protection and Switchgear
https://nptel.ac.in/courses/108/107/108107167/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE623	**Power System Protection**	**3**	**0**	**2**	**0**	**4**

Syllabus (Theory)

UNIT I: INTRODUCTION AND PHILOSOPHY OF A PROTECTIVE RELAYING SYSTEM: Types of Faults, Functions of Protective Relays, Testing and Maintenance of Relays, Fuses.
UNIT II Instrument Transformer: Current transformer, potential transformer. **Different Types of Relays:** Electromagnetic relays, static relays. IEC60255 and BS142 standards
UNIT III: CIRCUIT BREAKERS: Theory of circuit interruption, circuit constants in relation to circuit breaking, theory and practice of conventional circuit breakers, recent developments in circuit breakers. IEC60898 standards.
UNIT IV: PROTECTION: Generator protection, transformer protection, protection of transmission lines, bus zone protection, and microprocessor based digital protection

Syllabus (Practical)

1. Study the burden effect on the performance of CT and measure ratio error.
2. Find out the sequence components of currents in three 1-Phase transformers and 3-Phase transformer and compare their results.
3. Checking characteristic and operation of Inverse Time Over Current relays having followed characteristic Electromechanical relays (to be performed in Lab and Virtual Lab environment).
   A. Extremely Inverse relay (EI)
   B. Very Inverse Relay (VI)
   C. Normal Inverse Relay (NI)
4. Checking characteristic and operation of percentage bias differential and plot the characteristics of a percentage bias differential relay for 20%, 30% and 40% biasing.
5. Study gas actuated Buchholz relay.
6. Study under/over frequency relay and check it's setting experimentally.
7. Study a typical grid substation.
8. To study the earthing.
9. To study the directional over-current relay in virtual lab environment.
10. To find out dielectric strength of transformer oil in virtual lab environment.

Text Book(s)

1. B Ravindranath and M Chander, "Power System Protection and Switchgear" TMH.
2. C L Wadhwa," Electrical Power System", New age international publisher.
3. J B Gupta, "Transmission & Distribution of Electrical Power", S. K. Kataria & Sons publication.

Reference Book(s)

1. Sunil S. Rao, "Switchgear and Protection", Khanna Publications New Delhi.
2. Y. G. Parithankarand S. R. Bhide, "Fundamentals of Power System Protection", PHI.

Course Title and Code: Computational Fluid Dynamics ME639 (Open Elective-I)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-VI (Batch: 2016-2020)/Elective**

Course Objective:

1. Equip students with the knowledge base essential for application of computational fluid dynamics (CFD) to engineering flow problems
2. Provide the essential numerical background for solving the partial differential equations governing the fluid flow
3. Develop students' skills of using a commercial software package (ANSYS Fluent)

After course completion, the student will be able to:

1. Use CFD tool to simulate the fluid flow and heat transfer phenomena in design and predict the system performance before manufacturing.
2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same.
3. Evaluate different flow computation methods and make appropriate choice.
4. Model flow problem properly within CFD context, using CAD package and meshing tool as per ASTM standards.
5. Use CFD software to model relevant engineering flow problems, p0stprocessing of the CFD results, compare with available data, and explain the findings.

	Prerequisites	Fluid Mechanics and Heat Transfer
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment (4)	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	Nil
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**

Syllabus (Theory):

Introduction to Computational Fluid Dynamics and Principles of Conservation: Computational Fluid Dynamics: What, When, and Why? CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation. The impact of CFD. The governing equations of fluid dynamics- models of the flow, The substantial derivatives, continuity equation, momentum equation, Energy equation, boundary conditions

Mathematical behavior of partial differential equations- Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations

Basic aspect of discretizations- Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term

Finite Volume Method - Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions

Discretization of Convection-Diffusion Equations- A Finite Volume Approach: Finite volume discretization of convection-diffusion problem: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume discretization of two-dimensional convection-diffusion problem, The concept of false diffusion, QUICK scheme.

Discretization of Navier Stokes Equations: Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm

Practical:

Interface with software, Simulation-1 Pipe flow, Meshing + BC, Simulation-2 Sudden Enlargement in c/s, Solver setting, Simulation-3 Flow around a vehicle, Full processing and post processing, Simulation-4 Fin Heat transfer

Textbooks:

1. PS Ghoshdastidar. "Computational Fluid dynamics and Heat transfer", Cengage
2. J. D. Anderson Jr. "Computational Fluid Dynamics" McGraw-Hill International Edition.
3. S.V. Patankar "Numerical Heat Transfer and Fluid Flow" Hemisphere
4. H.K. Versteeg and W. Malalasekera "An introduction to computational fluid dynamics: The finite volume method" Pearson Education

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME301	Engineering Thermodynamics	3	1	0	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)				
Mid Term Test – I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation	Additional Continuous Evaluation*	Total Marks
20	20	50	10	100	-	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

UNIT-I

Basic Concepts: Macroscopic and Microscopic Approach, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasistatic, Reversible and Irreversible Processes, Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility.

UNIT-II

Ideal & Real Gases - Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avagadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states, Mixture of Gases, Bass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of Gases.

UNIT-III

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots during Steam formation, Properties of Dry, Wet and Superheated Steam, Property Changes during Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.

UNIT-IV

First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, 1st Law Applied to Non-Flow Process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process.

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir Heat Source and Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot's Theorem and its Corollaries.

UNIT-V

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics.

Availability, Irreversibility and Equilibrium: High- and Low-Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility. Thermodynamic Relations: Tds Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations

Text Book(s)

1. Thermal Science and Engineering – D S Kumar, S K Kataria and Sons
2. Fundamentals of Engineering Thermodynamics, Yadav R., 8th edition, 2004, (Formerly, Thermodynamics and Heat Engines, Vol I), Central Publishing House, Allahabad

3. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
4. Engineering Thermodynamics, Nag P.K., 2nd edition, 1995, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
5. Engineering Thermodynamics – Congel & Boles, Tata McGraw Hill
6. Thermodynamics, Holman, J.P., 4th ed., McGraw-Hill book Co. New York

Reference Book(s)

1. Fundamentals of Thermodynamics, Van Wylen, G.J. and Sonntag, R.E., John Wiley & Sons Inc, New York, 2000
2. Engineering Thermodynamics, Spalding, D.B. and Cole, E.H., Edward Arnold.
3. Engineering Thermodynamics: Work and Heat transfer – G F C Rogers Maghew Y R Long man

Web link:

1. https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLeRx4palfirbdOTXXYf4MoW3eM4dFIgR9
2. https://www.mooc-list.com/course/me209x-thermodynamics-edx
3. https://www.coursera.org/learn/thermodynamics-intro.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME306	**Strength of Materials**	**3**	**0**	**2**	**0**	**4**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	**Mid Term Test - II**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****	**Mid Term Test - I**	**End Term Test**	**Class Participation/ Additional Continuous Evaluation***	**Total Marks ****
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I

Prerequisite mechanics, stresses and strains, Stress-Strain Diagrams, Hooke's law, Poisson's ratio, Strain energy due to axial loading, Resilience, Elastic Constants& their relationship.

Principle of Superposition, analysis of axially loaded members: Composite bars in tension and compression - temperature stresses in composite rods

Compound Stress & Strain-, Principal planes, principal stress and strain, maximum normal and shear stresses, Mohr's Circle of stresses, volumetric Strain.

UNIT II

Shear force and bending moment for simple beams: types of beams, load and supports, support reactions, Relation between Rate of loading the shear force and bending moment, Shear force and bending moment diagram, point of inflection.

Simple Bending of beams: Theory of simple bending, Flexure formula, Section Modulus, Composite beam in Circular, Rectangular, I, T& Channel Section, Shear stress in bending, Shear stress Distribution, Combined Stresses in beam, Numerical.

UNIT III

Slope & Deflection - Relationship between bending moment, slope & deflection, method of integration, Macaulay's method, for calculations of slope and deflection of cantilevers and simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

Torsion - Torsion of hollow and solid Circular Shaft within elastic limit, Composite Shaft, Torque and Horsepower, angle of twist, torsion equation, Assumptions, Numerical.

UNIT IV

Columns & Struts-Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler theory for the elastic buckling load, Rankine's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

Thin Cylinders & Spheres- Hoop and longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, Numerical. Close coiled helical spring, numerical.

Syllabus (Practical)

1. Universal Testing Machine UTE-20.
2. Impact Tester, IT-30.
3. Torsion Testor, TTE-10.
4. Rockwell Hardness Tester.
5. Brinell's Hardness Tester.
6. Vickers Hardness Tester, VM-50.
7. Fatigue Testing machine, FTG 8(D).
8. Bending Stress in a Beam, STR 5.

9. Compression Test

Textbook(s)

1. Hibbeler, R.C., **"Mechanics of Materials SI",** Prentice Hall.
2. Beer, F.P., Johnston, E.R., DeWolf, J.T., "**Mechanics of Materials**", McGraw Hill.
3. Rattan, S.S., **"Strength of Materials**", McGraw Hill, New Delhi.

Reference Book(s)

5. Andrew Pytel and Fredinand L. Singer, "Strength of Materials" Int. Student Ed.
6. Popov, "Strength of Materials" PHI, New Delhi.
7. Sadhu Singh, "Strength of Materials" Khanna Publications.
8. Dr. R. K. Bansal, "Strength of Materials" Laxmi Publications.

Web link:

1. https://www.youtube.com/watch?v=A1SWKe6ZwVc&list=PL2D5AE008C055CC4F
2. https://www.youtube.com/watch?v=GkFgysZC4Vc&list=PL27C4A6AEA552F9E6
3. https://www.springboard.com/udemy/mechanical-strength-of-materials/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME308	Fluid Mechanics & Machines	3	1	2	0	5

Mid Term Test – I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I

Fluid Properties and Fluid Statics-Concept of fluid, ideal and real fluids, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium.

UNIT II

Fluid Kinematics-Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, stream and potential functions, flow net.

UNIT III

Fluid Dynamics-Concept of system and control volume, Euler's equation, Bernoulli's equation, Pitot tube, venturimeter, orificemeter, flow through orifices & mouthpieces**,** Hagen-Poiseuilli Law, hydraulic gradient and total energy lines, major and minor losses in pipes. Power transmission though pipes, branched pipes- parallel and series.

UNIT IV

Boundary Layer Analysis-Boundary layer concept, displacement, momentum and energy thickness of boundary layer. Laminar and turbulent boundary layer flows drag on a flat plate, boundary layer separation and control. Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes.

UNIT V

Fluid Machines-Analysis and design of rotodynamic pumps and turbines, Specific speed, Performance characteristic curves and selection of pumps and turbines, Single and multi-stage machines, Various head losses and respective efficiencies, Cavitations, Governing of turbines and priming of rotodynamic pumps, Analysis and design of reciprocating pumps and other machines such as hydraulic accumulator, coupling and torque converter, Performance characteristics and efficiencies

Syllabus (Practical)

1. To determine coefficient of discharge of an orificemeter.
2. To determine the coefficient of discharge of Notch (V and Rectangular types).
3. To determine the friction factor for the pipes.
4. To determine the coefficient of discharge of venturimeter.
5. To verify the Bernoullis Theorem.
6. To find critical Reynolds number for a pipe flow.
7. To determine the meta-centric height of a floating body.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To draw the following performance characteristics of Pelton turbine-constant head, constant speed and constant efficiency curves.
10. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.
11. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
12. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.

13. To study the construction details of a Gear oil pump and its performance curves.
14. To study the constructional details of a Hydraulic Ram and determine its various efficiencies.

Text Books:

1. D S Kumar, “Fluid Mechanics and Fluid Power Engineering” S K Kataria and Sons.
2. Modi & Seth, “Hydraulics & Fluid Mechanics “Standard Book House.
3. S S Rattan, “Fluid Mechanics and Hydraulic Machines” Khanna Publishers.

Reference Books:

1. Streeter V L and Wylie E B, “Fluid Mechanics” Mc Graw Hill.
2. I H Shames, “Mechanics of Fluids” Mc Graw Hill.
3. S K Som and G Biswas, “Introduction to Fluid Mechanics and Fluid Machines” Tata McGraw Hill.

Web Link:

1. https://www.youtube.com/watch?v=HGbbdXNcIQA&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt
2. https://www.youtube.com/watch?v=fa0zHI6nLUo&list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm
3. https://www.class-central.com/mooc/5291/nptel-introduction-to-boundary-layers
4. https://www.class-central.com/mooc/6562/nptel-fluid-machines
5. https://legacy.saylor.org/me201/Intro/

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME408	Heat Transfer	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**The ratio of weightage between Theory and Practical content will be 60%: 40%

Syllabus (Theory)

UNIT I

Introduction to Heat Transfer Processes- Conduction and radiation, Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity, Newton's law of cooling, definition of overall heat transfer coefficient, general parameters influence the value of heat transfer coefficient. Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates, different kinds of boundary conditions, nature of differential equations, one dimensional heat conduction with and without heat generation, electrical analogy, heat conduction through composite walls, critical thickness of insulation.

UNIT II

Heat Transfer from Finned Surfaces- fin efficiency and effectiveness, two-dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction. Convection: Review of Navier–Stokes and energy equation, hydrodynamic and thermal boundary layers, laminar boundary layer equations, forced convection appropriate non dimensional members, effect of prandtl number, empirical relations for flow over a flat plate and flow through pipes.

UNIT III

Natural Convection- Dimensional analysis, grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations. Heat Transfer with Change of Phase: Nature of vaporization phenomena, different regimes of boiling heat transfer, correlations for saturated liquid vaporization, condensation on flat plates, correlation of experimental results, drop wise condensation.

UNIT IV

Heat Exchanger- Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger, effectiveness of heat exchanger, N.T.U. method, fouling factor, constructional and manufacturing aspects of Heat Exchangers.

UNIT V

Thermal Radiation- Plank distribution law, Kirchhoff's law, radiation properties, diffuse radiations, Lambert's law, radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies, shape factor, electrical analogy, reradiating surfaces heat transfer in presence of reradiating surfaces.

Syllabus (Practical)

1. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
2. To Measure the thermal Conductivity of Liquid.
3. To determine the transfer Rate & Temperature Distribution for a Pin Fin.
4. To Measure the Emmissivity of the Test plate Surface.
5. To Determine Stefan Boltzman Constant of Radiation Heat Transfer.
6. To Determine the Surface Heat Transfer Coefficient for Heated Vertical Cylinder in Natural Convection.
7. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.

8. To Study Performance of Simple Heat Pipes.
9. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10. To Find the Heat transfer Coefficient in Forced Convection in a tube.

Text Book(s)

19. Holman J.P. “Heat Transfer” Tata McGraw-Hill, New Delhi.
20. Cengel “Heat and Mass Transfer” Tata McGraw-Hill, New Delhi.

Reference Book(s)

1. Kumar D.S. “Heat and Mass Transfer” Kataria and Sons.
2. Nag P.K. “Heat and Mass Transfer” Tata McGraw-Hill, New Delhi.
3. Thirumaleshwar M. “Fundamental of Heat and Mass Transfer” Pearson Education.
4. Rajput R.K. “Heat Transfer” S. Chand Publication.

Web link:

1. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
2. https://www.springboard.com/udemy/mechanical-heat-and-mass-transfer/
3. https://www.class-central.com/mooc/5302/nptel-conduction-and-convection-heat-transfer

Course Title	**Production Technology – I**
Course Code	**ME405**
Hours per Week (L T P)	**3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Batch: 2018-2022)/Core**

Course Objective:
To impart knowledge about principles/methods of casting with knowledge of pattern, molding, casting methods in order to get sound casting. To impart knowledge about welding processes in order to get sound permanent joints of metal and metal alloys. To impart knowledge of working principles of various non-conventional and advanced machining processes.

Learning Outcome:
On successful completion of this course, the students will be able to:

- IL1202.6. Design molding system to obtain defect free cast.
- IL1202.7. Analyze various welding processes for different applications.
- IL1202.8. Identify non-conventional manufacturing process to manufacture intricate shaped product accurately.
- IL1202.9. Identify latest manufacturing systems and processes for manufacturing of components.

Prerequisites: Basics of Materials Engineering

Sr. No	Specifications	Marks	Marks (Post COVID)
1	Attendance	5	5
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	5	15
5	Theory Exam-I	10	10
6	Theory Exam-II	NIL	
7	Theory Exam-III	30	30
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	20	
12	Project-II	NIL	
13	Project-III	NIL	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	
16	Course Portfolio	NIL	
	Total (100)	**100**	**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
	Total (30)	**30**

Course Syllabus (Theory)

Conventional Manufacturing processes:
UNIT-I
Casting and molding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, gating system design, riser design, casting defects and residual stresses.
Melting Practices: Cupola, Induction Furnaces

UNIT-II
Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes, welding defects; Adhesive bonding.

Unconventional Machining Processes:

UNIT-III

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters.

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

UNIT-IV

Introduction to Flexible Manufacturing System, Additive manufacturing: Rapid prototyping and rapid tooling.

Text Book(s)

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
4. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

Reference Book(s)

1. Rao P. N. "Manufacturing Technology: Foundry, Forming and Welding" TMH, 2013.
2. James S. Campbell "Principles of Manufacturing Materials and Processes", TMH.
3. G.E. Linnert, "Welding Metallurgy" AWS.
4. Cook "Manufacturing Analysis" Adisson-Wesley
5. R. K. Jain "Manufacturing Engineering Technology" Pearson Education
6. P. C. Pandey and C. K. Singh "Production Engineering Sciences" Standard Publishers Ltd.

Course Syllabus (Practical):

1. To determine moisture content in molding sand,
2. To determine the clay content of molding sand,
3. To perform the Hardness Test to know hardness of molding/core sand.
4. To prepare wood/metal pattern for casting process.
5. To cast a liquid Aluminum metal by using sand molding.
6. Investigate the casting defects and suggest the remedial measures.
7. To make a component involving horizontal and vertical welding using gas welding.
8. To make a component using TIG welding setup.
9. To make a component using MIG welding setup.
10. To prepare a permanent joint on mild steel plate using gas welding.
11. To prepare a permanent joint on thin metallic sheet using spot welding.
12. To find out average grain fineness number using sieve shaker.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME411	Mechanical Measurements	3	0	2	0	4

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test – II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks	Mid Term Test - I	End Term Test	Class Participation Additional Continuous Evaluation*	Total Marks
20	20	50	10	100	20	50	30	100

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Syllabus (Theory)

Unit I

Basic Concepts of Measurement-General measurement system; Experimental test plan: true value, accuracy, readability, precision, bias, uncertainty, Calibration: Static calibration, dynamic calibration, static sensitivity, traceability, reproducibility, reliability, repeatability, resolution, range, Error: sources of errors, types of errors in measurement, Presenting data: Rectangular coordinate format, semi-log, full-log formats. Measurement System Behavior.

Unit II

Temperature Measurement- Bimetallic Thermometers Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards.

Unit III

Fluid flow Measurement-Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids Flow measurement: Pressure differential meters: Orifice meter, Venturi meter, rotameter.

Unit IV

Strain Measurement-, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple gauge bridge, bridge constant, apparent strain and temperature compensation, . Motion, Force and Torque Measurement: Displacement measurement: Potentiometers, Linear variable differential transformers, rotary variable differential transformer; Velocity measurement: moving coil transducers; angular velocity measurement: electromagnetic techniques, stroboscopic measurement; Force measurement: load cells, piezoelectric load cells; Torque measurement: measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

UNIT-V

Metrology- standards of measurement, , Concept of Limit, fits and tolerances, hole & shaft basis system, Taylor's principle, limit gauges. Interchangeability and selective assembly. Linear and angular measurements devices, screw gauge, Vernier caliper, sine bar, autocollimator, comparators mechanical, electrical & optical type, surface finish and its measurement, elements of surface texture, methods of measuring surface finish, Sigma, Johansson's Microkrator. Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope, profile projector, Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears.

Syllabus (Practical):

1. Study of various temperature measuring devices; thermo couple, RTD, gas thermo meters.
2. Measuring velocity of fluid flow by Ventura meter/ orifice meter/ pitot-tube.
3. Measuring torque and power generated by a prime mover by using pony brake dynamometer.
4. Study of various pressure measuring devices like manometers, mercury in glass pressure gauge.
5. To develop a measuring device for fluid level measurement.
6. Measurement of angle by using sine bar.
7. Forces measurements during orthogonal turning.

References:

1. Nakra and Chowdhry, “Measurement and Control” TMH
2. Figiola R S & Beasley DE “Theory and Design for Mechanical Measurements” John Wiley
3. Katsuhiko Ogata “Modern Control Engineering” Pearson Education, New Delhi
4. Backwith and Buck “Mechanical Measurements”.
5. Swahney “Metrology and Instrumentation”

Web Link:

1. https://www.youtube.com/watch?v=lc4dsNvm2Ks&list=PL70EFDD69A84246B0
2. https://www.youtube.com/watch?v=8DTt-f6wQxE&list=PL522E677B167D6CB5
3. https://www.youtube.com/watch?v=SOHTg9EFE5g&list=PL3txkL3SesVb4YIHlK-COA3drxidb-mb3
4. http://nptel.ac.in/courses/112106138/
5. http://www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html
6. http://www.qimtonline.com/course/index.php?categoryid=84

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ME410	**Materials Science & Engineering**	**2**	**0**	**0**	**0**	**2**

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test - I	Mid Term Test - II	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **	Mid Term Test - I	End Term Test	Class Participation/ Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	-	-	-	-

*Additional Continuous Evaluation: Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

Course Syllabi (Theory):

UNIT I

Crystallography- Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numerical related to crystallography

UNIT II

Imperfection in metal crystals- Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

Solid solutions and phase diagram- Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

UNIT III

Heat Treatment- Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, hardenability, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

UNIT IV

Deformation of Metal-Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking. Recovery, re-crystallization and grain growth

Failures of metals-Process of fracture, types of fracture, fatigue failure, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue, failure analysis.

UNIT V

Creep and Corrosion- Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism, types of corrosion, effect of corrosion, prevention of corrosion.

Engineering alloys- Heat resistant, corrosion resistant, super alloys, carbon and alloys tool steels and high-speed steels, ceramics: preparation and applications

Text Books:

1. George E. Dieter "Mechanical Metallurgy"
2. V. Raghvan "Material Science & Engineering" Prentice Hall of India Pvt. Ltd, New Delhi
3. Narula, Narula and Gupta "Material Science" New Age Publishers
4. O.P. Khanna "A Textbook of Material Science & Metallurgy" Dhanpat Rai & Sons

Reference Books:

1. Callister; W.D. “Material Science and Engineering-An Introduction” John Wiley & Sons, Delhi.
2. Kenneth G. Budinski “Engineering Materials” Prentice Hall of India, New Delhi

Web Link:

1. https://www.youtube.com/watch?v=b4jvpYxxZco&list=PLE34EAAA410160DD6
2. https://www.youtube.com/watch?v=RJ-OCEz7wd0&list=PLbMVogVj5nJQ5jqiXDYuE6ETz5F5Kn4dA
3. https://www.youtube.com/channel/UC9sKRSg8Kn5axYdORJUnqFw
4. https://ocw.mit.edu/courses/materials-science-and-engineering/
5. https://www.pearsonhighered.com/product/Shackelford-Introduction-to-Materials-Science-for-Engineers-8th-Edition/9780133826654.html
6. https://www.springboard.com/udemy/core-materials-science/

Course Title and Code Introduction to Aeronautical Engineering (ME1402)	
Hours per	**10–12 (7 weeks)**
Credits	**4**
Students who can take	**B. Tech Semester-VII (Core)**
Course Objective: This course introduces the fundamentals of aeronautics, using a tour through the history of flight, starting with ballooning and continuing to airplanes and helicopters.	

On successful completion of this course, the student should be able to:

- identify and model the earth's atmosphere for aircraft design
- analyse the aircraft stability, structures, navigation and propulsion
- design aircraft wings applying aerodynamics principles
- identify and analyse aircraft climb, descend and cruise

Evaluation scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	
2	Assignment	15
3	Class Participation	
4	Quiz	15
5	Theory Exam-I (MOOC)	15
6	Theory Exam-II (MOOC)	15
7	Theory Exam-III (MOOC)	30
8	Report-I	10
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	
15	Lab Evaluation-II	
16	Course Portfolio	
		100
	Evaluation scheme for Re-test	
1	Theory Exam-III	30
	Total	**30**

Syllabus:

Module A: Introductory module

Introduction + Ballooning, The International Standard Atmosphere, How aircraft fly, Cockpits & Instruments, **Structural** concepts, **Stability** & Control, Propulsion, Materials & Exploring the limits, Special vehicles Module A: Introductory module

Module B: Aerodynamics

Introduction to Aerodynamics, Compressibility, Viscous flows, Pressure distributions and flow separation, Airfoils, Critical Mach number, Finite wings

Module C: Flight Mechanics

Introduction to flight mechanics, Horizontal flight performance, Climbing and descending flight, The flight envelope

Textbooks:

1. Anderson, “Introduction to Flight”, McGraw Hill Education
2. Torenbeek, “Flight Physics” Springer

Reference Course

1. https://www.edx.org/course/introduction-to-aeronautical-engineering-2, TUDelft.
2. https://nptel.ac.in/courses/101/105/101105059/, IIT Kharagpur

Course Title and Course Code	**Computer Aided Modeling and Simulation (ME1206)**
Hours per Week	**L T P: 1 0 2**
Credits	**2**
Students who can take	**B. Tech Semester-IV & VI ME**

Course Objective:
To develop competencies in CAD modeling and simulation for effective concurrent engineering.

Learning Outcomes:
On successful completion of this course, the students will be able to:
1. design mechanical parts using CAD software.
2. assess the use of tool to create, constrain, and edit sketched features.
3. assess the use of modeling & assembly tools to create and constrain components.
4. generate simulation results for any machine part and assembly.

Prerequisites		**Basics of Physics**		
Sr. No	**Specifications**	**Marks**	**Marks (Post COVID)**	
1	Attendance	5	5	
2	Assignment	25	25	
3	Class Participation	NIL	NIL	
4	Quiz	NIL	NIL	
5	Theory Exam-I	NIL	NIL	
6	Theory Exam-II	NIL	NIL	
7	Theory Exam-III	NIL	NIL	
8	Report-I	NIL	NIL	
9	Report-II	NIL	NIL	
10	Report-III	NIL	NIL	
11	Project-I	40	40	
12	Project-II	NIL	NIL	
13	Project-III	NIL	NIL	
14	Lab Evaluation-I	15	15	
15	Lab Evaluation-II	15	15	
16	Course Portfolio	NIL	NIL	
	Total (100)	**100**	**100**	
Evaluation Scheme for Retest		**Marks**		
1	Lab Evaluation-Retest	30	30	30
Total (30)		**30**	**30**	**30**

COURSE SYLLABUS:
UNIT – I
Introduction to 2-D & 3-D Modeling:
Creating a New Part File, Sketched Base Features, Primitive Base Features, Sketch Geometry, Advanced Editing Tools, Rectangle & Circular Sketch Patterns, Over-Dimensioned Sketches, Sketch Preferences, Extruded Secondary Features, Revolved Secondary Features, Using Existing Geometry, Editing Sketched Secondary Features, Edge Chamfer, Constant Fillets, Variable Fillets, Face Fillets, Full Round Fillets, Straight Holes, Threads, Creation Sequence, Section Views.
UNIT - II
Advance 3-D modeling and Assembly:
Creating a New Part, Rail Lofts, Center Line Lofts, Advanced Loft Options, Rectangular Feature Patterns,

Circular Feature Patterns, Mirror Parts or Features, Manipulate Patterns and Mirror Features, Assembling Components using Constraints, Content Center, Assembly Browser, Assembling Components using Joints, Moving and Rotating Assembly Components, Selection Options in Assemblies, Measurement Tools, Model Properties, Assembly Parts, Assembly Features.

UNIT - III

Surfacing, and Drafting:

New Drawing Views, Manipulating Views, Dimensions, Drawing Sheets, Parts List, Balloons, Styles and Standards, Hatching, Text, Symbols, Hole and Thread Notes, Chamfer Notes, Center Marks and Center Lines, Hole Tables, Revision Tables and Tags.

UNIT - IV

Static & Dynamic Simulation

General Working of FEA, Nodes, Elements, General Procedure of Conducting Finite Element Analysis through inventor, Structural Analysis, Material Properties, Mesh Generation, Mesh Density, Defining the New Analysis Type, Restarting the Analysis, Setting Analysis Options, Solving the Analysis Problem, Dynamic Analysis.

Text Books:

9. Tickoo, Sham. Autodesk Inventor 11 For Engineers & Designers (With Cd). Dreamtech Press, 2006.
10. Shih, Randy. Parametric Modeling with Autodesk Inventor 2014. SDC Publications, 2013.
11. Bethune, James D. Engineering Design Graphics with Autodesk Inventor 2020. Macromedia Press, 2019.
12. Zeid, Ibrahim. CAD/CAM theory and practice. McGraw-Hill Higher Education, 1991.

Course Title and Course Code	**Theory of Machines (ME1108)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-V (Batch: 2017-2021)**

Course Objective:
This course aims to impart knowledge on design and analysis of mechanism for the specified type of motion in a machine and transmission systems.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Compare and develop various application-based linkages and mechanisms
- Analyze velocity and acceleration polygon of different types of mechanisms.
- Analyze the cam and follower mechanism in order to optimize the power consumption.
- Prioritize among various mechanisms like belt, rope and chain drive systems in order to minimize energy consumption.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT - I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

(8)

UNIT - II

Kinematic Analysis of Mechanisms:

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation. **(8)**

UNIT - III

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams-

Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

(8)

UNIT – IV

Belts, Ropes and Chains: Mechanism of belt, rope and chain drive, power transmitting capacity, effect of centrifugal forces, material used for Belts, rope and chain. **(8)**

Vibration: Introduction to vibration, single degree of freedom (free Vibration) **(8)**

COURSE SYLLABUS (Practical):

1. (i) To study the various types of link, and pair mechanism.
   (ii) To study the inversions of four bar mechanism.
2. To determine whirling speed of shaft theoretically and experimentally.
3. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
4. To determine the natural frequency of un-damped torsional vibration of a single rotor shaft system.
5. To determine the natural frequency of un-damped torsional vibration of two rotor shaft system.
6. To Analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
7. To determine the frequency of un-damped free vibration of an equivalent spring mass system.
8. To determine the frequency of damped force vibration of a spring mass system.
9. To study the static and dynamic balancing using rigid blocks.
10. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

Text Books:

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2ND Edi. 2006.
3. Jagadish Lal, 'Theory of Machine', Dhanpat Rai Publications, New Delhi.

Reference books:

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD University press.2004
2. "Theory of Machines -I", by A. S. Ravindra, Sudha Publications, Revised 5th Edi. 2004.
3. "Theory of Machines ", by Thomas Bevan, CBS Publishers and Distributors.

Course Title and Course Code	**PRODUCTION TECHNOLOGY - II (ME1109)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-V (Batch: 2017-2021)**

Course Objective:
The main objective of the course is to impart knowledge of production technology so that students can able to design and perform various forming and machining processes to shape materials for different applications.

Learning Outcomes:
On successful completion of this course, the students will be able to:

- Design load capacity of forming equipment to perform various bulk forming and sheet forming operations.
- Design of machining tools, forming tools and holding tools for various forming and machining processes.
- Calculate force required for machining metallic materials using appropriate cutting tool materials and cutting fluids.
- Use cutting, milling, and finishing operations to shape materials and evaluate their surface finish using conventional and automatic machines.

Prerequisites		**Basics of Materials Engg, PT-I**
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Course Contents:

UNIT - I

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder metallurgy. **(8)**

UNIT - II

Tooling for conventional and non-conventional machining processes: Mold and die design, Press tools, Cutting tools; **(6)**

Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(6)**

UNIT - III

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, cutting tool materials, Cutting fluids. **(10)**

UNIT - IV

Turning, Drilling, Milling and finishing processes, Surface finish and integrity, Coating. **(8)**
Introduction to CNC machining. **(2)**

Course Syllabus (Practical)

1. Study of single point cutting tool geometry & grind the tool as per given tool geometry.
2. To prepare a job using lathe machine.
3. To prepare a gear using Milling Machine.
4. Study the milling machine, milling cutters, indexing heads and indexing methods.
5. Prepare a hexagonal / octagonal nut using indexing head on milling machine.
6. To cut external metric threads & to meet it with the nut
7. To prepare the job by eccentric turning on lathe machine.
8. To prepare a job on shaper from given MS rod.
9. To prepare a job on surface grinder and measure the various parameters of the finished piece.
10. Disassembly and assembly of small assemblies such as three jaw chuck, four jaw chuck, tail stock, bench vice, screw jack etc.

Text Books:

5. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
6. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
7. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
8. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="4">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Credits</th></tr>
<tr><td>EE1403</td><td>Energy Production, Distribution and Safety 2017-21
(Curated MOOC-Coursera)</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>

Course Objectives: This course is aimed at developing the required understanding of electric power systems, natural gas, safety practices, and the energy industry. It focuses on standards and policies of the electric utility industry, characteristics and properties of natural gas and management of the safe working environment.

Prerequisites: Basic Electrical Engineering.

Learning Outcomes

On successful completion of this course, the student will able to:

1. Design and analyze the generation, transmission, and distribution systems.
2. Compare the applicability of various energy conversion processes to different applications from technological, economic and environmental perspectives.
3. Consider safety, environmental and economic aspects with respect to Natural Gas chain.
4. Identify and use components, mechanical machinery and instrumentation in the Natural Gas value chain from well to product.
5. Implement the Health and Safety Management Systems.
6. Verify the power system variables as per electricity act.

Syllabus

Basic Electricity, Generation, Transmission, & Distribution, System Design & Switching, Renewable Energy & Smart Grid Technologies, Exploration of Natural Gas, Natural Gas Processing, Transmission & Storage, Liquefied Natural Gas, Distribution, & Construction, Safety & Customer Service, Hazards & Response, Preparing for Hazards in the Workplace, Safety Administration & Management, Energy Touches Everything, Energy Sources, Energy & Utility Solutions, opportunities and preparation for a future in energy fields

Textbooks

1. Kothari. D. P., Nagrath. I. J., "Power System Engineering", Tata McGraw-Hill Publishing Company Limited, 2nd Edition, Third Reprint, New Delhi, 2008.
2. Gupta, B.R., "Power System Analysis and Design", S. Chand & Company Ltd., Reprint Edition, New Delhi, 2007.
3. Mokhatab, S., Mak, J.Y., Valappil, J.V. and Wood, D.A., "Liquefied Natural gas", Elsevier, USA.
4. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards" CRC Press.

Course Assessment:

Prerequisites		Transmission and Distribution
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	Nil
2	Assignment	15
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	25

8	Report-I	10
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	MOOC-Coursera Certification	40
	Total (100)	100
Retest		
Theory Exam-III		25
Total (25)		25

Course Title and Course Code	**Internal Combustion Engines (ME1201)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII**

Course Objective:
The main objective of the course is to give the students an introduction to reciprocating internal combustion engines. It also aims to develop competencies among students for analyzing the performance parameters of the engines.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Design different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
- Analyze power cycle efficiencies of internal combustion engines for ideal gas cycles, and air-fuel cycles.
- Design various components of exhaust emissions and demonstrate the mechanisms of emission formation.
- Analyze exhaust emission systems for fuel quality and engine performance.

Prerequisites		**Thermodynamics, Heat Transfer**
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10+10(MOOC's)
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	20
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	**30**
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT - I

Air standard cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems. **(10)**

UNIT - II

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I.

Engines; elementary carburetor, Requirements of a diesel injection system; types of injection systems; petrol injection, Requirements of ignition system; types of ignition systems, ignition timing; spark plug. **(4)**

Combustion in S. I. Engines: Ignition limits, Stages of combustion in SI engine, effect of engine variables on ignition lag, effect of engine variables on flame propagation, rate of pressure rise, abnormal combustion, detonation or knocking, effects of detonation. **(4)**

Combustion in C. I. Engines: Stages of combustion, air-fuel ratio in CI engines, delay period or ignition lag, variables affecting delay period, diesel knock, and methods of controlling diesel knock. **(2)**

UNIT - III

Lubrication and Cooling Systems: Lubrication principles, hydrodynamic lubrication, Functions of the lubricating system, Properties of the lubricating oil, SAE rating of lubricating oils, Service rating of oils, Types of lubrication systems; mist, wet sump and dry sump lubrication systems; engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators. **(6)**

UNIT – 1V

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; speed, fuel and air consumption, brake power, indicated power and friction power, heat going to cooling water and exhaust gases; performance curves. Problems. **(8)**

Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Mechanism of formation of pollutants in SI engines, Exhaust emission, emission of unburnt hydrocarbon. Mechanism of formation of pollutants in CI engines. Methods of emission control; alternative fuels for I.C. Engines. **(8)**

COURSE SYLLABUS (Practical):

- To study the constructional details & working principles of two-stroke or four stroke petrol engine/related case study.
- To study the constructional detail & working of two-stroke or four stroke diesel engine/ related case study.
- To draw valve timing diagram of two stroke/four stroke petrol and diesel engines/ related case study.
- To find the indicated horsepower (IHP) on multi-cylinder petrol engine by Morse Test/ related case study.
- To perform constant speed performance test on a single cylinder diesel engine & draw curves of bhp vs fuel rate, air rate, bhp vs mep, mechanical efficiency & sfc/ related case study.
- To perform variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
- To perform constant speed performance test on a single cylinder petrol engine & draw curves of (i) bhp vs fuel rate, air rate and (ii) bhp vs mep, mechanical efficiency & sfc.
- To perform variable speed performance test of a single cylinder petrol engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
- To prepare heat balance sheet on multi-cylinder petrol engine/ related case study.
- To prepare heat balance sheet on single cylinder diesel engine/ related case study.

Text Books:

3. Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, 2nd Edition, Pearson Prentice Hall, 2004.
4. Internal Combustion Engines –V. Ganesan, Pub.- McGraw-Hill.
5. Internal combustion engines-- M. L. Mathur, R. P. Sharma, Dhanpat Rai Publications, 2014
6. Internal Combustion Engines and Air Pollution-- R. Yadav, Central Publishing House, Allahabad 2012
7. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York.

Course Title and Course Code	**Mechanical Vibration (ME1208)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of mechanical vibration and its area of application.

Learning Outcomes:
On successful completion of this course, the students will be able to:
- identify types of vibration.
- Create a model for a system and evaluate under free and damped vibrations.
- Create a model for a system and evaluate under forced excited and forced damped vibrations.
- Analyze degree of freedom for any mechanical system.

Evaluation scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	15
3	Class Participation	NIL
4	Quiz	15
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	10
15	Lab Evaluation-II (Exam)	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Retest

1.	Theory Exam	30
2	Lab Evaluation (Exam)	10
Total		40

COURSE SYLLABUS (Theory):

UNIT I

Fundamentals-Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic

Analysis, Fourier Series Expansion.

UNIT II

Free and Damped Vibrations-Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of various Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

UNIT III

Harmonically Excited Vibrations-Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent Viscous Damping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

UNIT IV

Two Degrees of Freedom Systems, principal mode of vibration, combine rectilinear and angular modes, Undamped force vibration with harmonic excitation, vibration absorbers, introduction to critical speed of shaft, introduction to multi degree of freedom system.

COURSE SYLLABUS (Practical):

1. Develop a virtual model-1 to conduct experiments for modal analysis.
2. Develop a virtual model-2 to conduct experiments for modal analysis.
3. Develop a virtual model-3 to conduct experiments for modal analysis.
4. Develop a virtual model-4 to conduct experiments for modal analysis.
5. Develop a virtual model-5 to conduct experiments for modal analysis.
6. Develop a virtual model-6 to conduct experiments for modal analysis.
7. Develop a virtual model-7 to conduct experiments for modal analysis.
8. Develop a virtual model-8 to conduct experiments for modal analysis.

Books:

1. Thomson, William T., and H. Saunders. "Theory of Vibrations with Applications." (1982): 156-156.
2. Feldman, Michael. Hilbert transform applications in mechanical vibration. John Wiley & Sons, 2011.
3. Rao, Singiresu S. Vibration of continuous systems. Vol. 464. New York: Wiley, 2007.
4. Grover, G. K., and S. P. Nigam. Mechanical vibrations. Nem Chand, 2009.
5. Den Hartog, Jacob Pieter. Mechanical vibrations. Courier Corporation, 1985.

Online course

1. https://nptel.ac.in/courses/112/103/112103112/

Course Title and Course Code	**Modelling of Engineering Materials (ME1209)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
O Students who can take	**B. Tech Semester-VII (Batch: 2017-2021)**

Course Objective:
The objective of this course is to get good exposure for the students to model the behavior of an engineering materials when subjected to a loading system.

Learning Outcomes:
On successful completion of this course, the students should be able to:

1. model and predict behavior of Engineering Materials under various loading conditions.
2. model and predict deformation in the engineering materials under various loading conditions.
3. identify types of composites for various applications.
4. design various application-based metal matrix composites.

Evaluation Scheme:

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
	Total (100)	**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
	Total (30)	**30**

COURSE SYLLABUS (Theory):

UNIT – I Modelling of Engineering Materials

Introduction to material modelling, Complexity of material response in engineering, Classification of modelling of material response, Coordinate frame and system, Tensors, Continuum Mech**,** Kinematics, Balance laws, Constitutive relations

Unit 2: Linear Mechanical Models of Material Deformation

Introduction to LMMMD, Linear elastic solid models, Classes of elastic constants, Materials with single plane of elastic symmetry, Isotropic materials, Maxwell model, Kelvin-Voigt model, Time temperature superposition

Unit-3: Introduction to composite

Define Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fiber composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Stiffness and Strength of composite: Geometrical aspects – volume and weight fraction. Unidirectional continuous fiber, discontinuous fibers, Short fiber systems, woven reinforcements Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

Unit 4: Metal Matrix Composites

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibers. Effect of reinforcement volume fraction rule of mixtures. Processing of MMC, powder metallurgy process, diffusion bonding, stir casting, squeeze casting, a spray process, Liquid infiltration, measurement of interface properties- applications of MMC in aerospace, automotive industries

Lamina Constitutive Equations, basic assumptions of laminated anisotropic plates. Laminate Constitutive Equations Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina properties from Laminate Tests.

COURSE SYLLABUS (Practical):

1. Study the mechanical behavior (under tensile loading) of fly ash composites
2. Study the mechanical behavior (under fatigue loading) of fly ash composites
3. Study the mechanical behavior (under impact loading) of fly ash composites
4. Study the mechanical behavior (under tensile loading) of aluminum alloy
5. Study the mechanical behavior (under fatigue loading) of aluminum alloy
6. Study the mechanical behavior (under impact loading) of aluminum alloy

Text Books:

1. Autar K. Kaw, Mechanics of Composite materials, CRC Taylor & Francis, 2nd Ed, 2005.
2. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3e, 2012.
3. Robert M. Jones, Mechanics of Composite Materials, Taylor & Francis, 1999.

Reference Books:

1. Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press,2004.
2. Michael W, Hyer, Stress analysis of fiber Reinforced Composite Materials, Mc-Graw Hill International, 2009.
3. Fibre Reinforced Composites, P.C. Mallik, Marcel Decker, 1993.
4. Handbook of Composites, P.C. Mallik, Marcel Decker, 1997.

Reference courses:

1. Introduction to Composites https://swayam.gov.in/nd1_noc20_me95/preview

Course Title and Course Code	**Computer Aided Product Design (ME1112)**
Hours per Week	**L T P: 2 0 4**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Batch: 2016-2020)** **B. Tech Semester-III (Batch: 2017-2021)**

Course Objective:
This course aims to expose the students to the various aspects of Industrial Design so as to design new products considering aesthetics, cost, environment and other human factors.

Learning Outcomes:
On successful completion of this course, the students will be able to:
- Read, understand and analyze drawing sheet of parts and assemblies as per standards.
- Develop 3D model of the parts as per the dimensional values.
- Assemble number of 3D model of parts together to check for its dimensional suitability and compatibility for an assembly.
- Generate the drafting sheet of assembled product with Bill of materials.

	Prerequisites	**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	20
15	Lab Evaluation-II	20
16	Course Portfolio	20
	Total (100)	**100**

Syllabus:
Concept of product design, Limits and fits, Geometric dimensioning and tolerance (GD&T).
Introduction to CAD software, Sketch Module, drawing commands in 2D Sketch.
3D Modelling tools with example like Extrude, Revolve, Sweep, Blend.
Editing commands like fillet, chamfer, holes, drafts, pattern.
Advance 3D modelling tool Relation, Family table, UDF.
Top down and bottom up assembly approach, mechanism in assembly
Drafting, bill of materials, sheet metal.
CNC programming.

Lab/ List of experiments

	Week 1-2	Week 3-5	Week 6-8	Week 9-10	Week 11-12
Month 1-3	Interface with software Sketcher Module	3D modelling Components Design using Software	Assembly Assembly of prepared parts and Mechanism	Drafting and Sheetmetal Preparing Draft Sheets of assembly, and sheet metal job	Aesthetical Design Prepare a aesthetical components and parts.

Text Books:

1. Prof. Sham Tickoo, "Creo Parametric 2.0 for Designers" CADCIM Technologies; 1st edition -2013.
2. Bruce A. Wilson, "GD&T: Application and Interpretation" Goodheart-Willcox Company, 5th edition - 2010.
3. Mikell P. Groover Embory W. Zimmers, "CAD/CAM Computer aided design and manufacturing" Dorling Kindersley India Pvt. Ltd. Pearson Education, 2008

Reference books:

1. Gaurav Verma, Matt Weber, "Creo Parametric 5.0 Black Book "CADCAMCAE Works 3rd edition -2018.

Gene Cogorno, "Geometric Dimensioning and Tolerancing for Mechanical Design, A Self-Teaching Guide to ANSI Y 14.5M1982 and ASME Y 14.5M1994 Standards" Mcgraw-hill, 2006

Course Title and Code	Design of machine elements- ME1110		
Hours per Week	**L-T-P: 3-0-2**		
Credits	**4**		
Students who can take	**B. Tech Semester-VI (Batch: 2017-2021)/ Core**		

Course Objective: This course aims to equip students with the concepts, procedure, and standards for designing and evaluating shafts, bearings, springs, and gears for different applications.

After course completion, the student will be able to:

1. Design and evaluate shafts to work under different service loading conditions as per ASTM/BIS standards.
2. Design bearings for various applications as per ASTM/BIS standards.
3. Design, evaluate gears for various applications as per ASTM/BIS standards.
4. Design springs for various systems as per ASTM/BIS standards.

Prerequisites	Strength of Materials and Engineering Mechanics.		
Sr. No	**Specifications**	**Marks**	**Marks (Post COVID)**
1	Attendance	NIL	
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	10	20
5	Theory Exam I	10	10
6	Theory Exam II	10	
7	Theory Exam-III	30	20
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	10	
12	Project-II	Nil	
13	Project-III	Nil	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	10
16	Course Portfolio	Nil	
	Total (100)	**100**	**100**

Syllabus (Theory)

UNIT-I

Design for Fluctuating Loads- Theory of failures, cyclic stress, fatigue and endurance limit, stress concentration factor, notch sensitivity, design for finite and infinite Life, Soderberg, Goodman & Gerber criteria.

Shafts- Material for shaft, stresses in shaft, design of shaft subjected to twisting moment, bending moment and combing twisting and bending moments, shaft subjected to fatigue load.

UNIT-II

Bearing- Classification of bearing, hydrodynamic lubrication, sliding contact bearing, design of journal bearing, thrust bearing-pivot and collar bearing, hydrodynamic thrust bearing.

Rolling contact bearing, types of rolling contact bearing, Bearing life, Selection of ball and roller bearings with ABMA Standards.

UNIT-III

Spur Gears- classification of gear, tooth forms, system of gear teeth, design consideration, Beam strength of gear tooth, dynamic tooth load, wear strength of gear tooth, failure of gear tooth, design of spur gears, AGMA standards.

Helical Gears: Terminology, forces components on a tooth of helical gear, virtual number of teeth, beam strength & wear strength of helical gears, dynamic load on helical gears.

UNIT-IV

Springs- Types of springs, design for helical springs against tension, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs.

Text Book(s)

1. Joseph Edward Shigley. "*Mechanical Engg. Design*" Tata Mc Graw Hill Book Co., 2006.
2. Bhandari, V B "*Design of Machine Elements*" Tata McGraw Hill, New Delhi., 2000.
3. PSG College of Engg. "*PSG Design Data Book*". PSG Publication.
4. K. Balveera Reddy & K. Mahadevan. "*Design Data Handbook*". 4th ed. CBS Publishers & Distributors, 497 pages, 2013.

Reference Book(s)

1. Dieter, G.E. and L.C. Schmidt, *Engineering Design*, 5th ed., McGraw-Hill Book Co, 825 pages, 2012.
2. Chitale, A. K., and R. C. Gupta. *Product design and manufacturing*. PHI Learning Pvt. Ltd., 2011.
3. Norton, Robert L. *Machine Design An Integrated Approach.* Pearson., 2006.
4. Kulkarni, S G . *Machine Design.* New Delhi: Tata Mcgraw Hill., 2008.

Syllabus (Lab)

1. Design an Oldham coupling and develop a 3D model.
2. Design a roller bearing and develop a 3D model.
3. Design a sliding contact bearing and develop a 3D model.
4. Design a spur gear and develop a 3D model.
5. Design a helical gear and develop a 3D model.
6. Design of spring under given condition and develop a 3D model.

Course Title and Course Code	**Automobile Engineering (ME1111)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI**

Course Objective:
The main objective of the course is: -

1. To make the student conversant with fundamentals of automotive systems
2. To develop competencies in performance analysis of vehicles

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Identify different part of the automobile.
- Design and explain the working of various parts like engine, transmission, clutch and brakes.
- Design a steering and suspension system.
- Identify Euro6 standards for automobile emissions.

Prerequisites		**Thermodynamics**
Sr. No	**Specifications**	**Marks**
1	Attendance	0
2	Assignment	20
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	25
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	**30**
	Total (30)	**30**

UNIT-I **(10 Hours)**

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

Unit II **(10 Hours)**

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced

Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT-III **(10 Hours)**

Transmission System: Manual transmission and types of gear box, sliding-mesh, constant-mesh and synchromesh gear boxes, types of dog clutches, gear shift mechanism, principles of automatic transmission. Clutch operation and types, multi-plate and cone clutches, clutch construction and lining. Propeller shafts, universal joints, slip joint, Hotch-Kiss drive and torque tube drive, transaxle and transfer case, radius rods, four-wheel drive arrangement. Automobile emissions, their harmful effects, pollution control measures, catalytic converters, exhaust system layout, mufflers, and resonators. Engine parameters, brief discussion of testing devices, engine service, engine tuning, engine re-boring, cyaniding, nitriding, de-carbonization.

UNIT-IV **(10 Hours)**

Braking System: Braking systems, layouts for mechanical braking, hydraulic braking, pneumatic braking, master cylinder, wheel cylinder, tandem cylinder, shoe brakes, disc brakes, requirements of brake fluid, power brakes, concept of ABS and traction control, parking brakes. Steering system, principles and need of steering, components parts, steering gear, steering ratio, steering lock, turning radius, centre point. Steering, wheel geometry, power steering principle and typical schemes.

Suspension System: Suspension system, functions of suspension, component parts, coil springs, leaf springs, air springs, shock absorbers, torsion bars, stabilizer bars, typical combinations of components in suspension systems, MacPherson strut suspension, its merits.

Wheel and tyres, wheel assembly and parts, pressed wheels and cast wheels, wheel rim, tyres, aspect ratio, tyres with tubes and tubeless tyres, advantages, construction of a tyre, plies, radial plies, tyre treads and tyre specifications.

Text Books:

1. Automotive Chassis- Heldt .P. M, Chilton Co., (Nyack, N.Y., P.M. Heldt, 1945) Literary Licensing, LLC, 2012.
2. Automotive Mechanics- N.K. Giri, 8th Edition, Khanna Publications, New Delhi, 2008.
3. Automobile Engineering / William H Crouse
4. Text Book Automobile Engineering–Manzoor, .Nawazish Mehdi & .Yosuf Ali, Frontline Publications.
5. Kamaraju Ramakrishna, “Automobile Engineering”, PHI Learning, New Delhi, 1st Print, 2012.
6. Jain &Asthana, “Automobile Engineering”, Tata McGraw-Hill, New Delhi, 2002.

Reference Books:

1. Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. Text Book of Automobile Engineering By Khalil U Siddiqui New Age International
6. Heinz Heisler, “Advanced Vehicle Technology”, Elsevier, New Delhi, 2011.
7. Crouse &Anglin, “Automotive Mechanics”, Tata McGrawHill, New Delhi, 10th Edition 2007.

Course Title and Course Code	**Autodesk CAD-CAM for Manufacturing Specialization (ME1403)**
Hours per Week	**L T P: Curated MOOC-Coursera**
Credits	**4**
O Students who can take	**B. Tech Semester-VII (Batch: 2017-2021)**

Course Objective: The key objective of this course is to get good exposure to work with CAD software and write CNC programming.

Learning Outcomes:

Students will be able to:

IL1202.10. demonstrate various processes of computer aided design, manufacturing, and toolpath creation.

IL1202.11. solve design-related vocabulary and visual literacy to articulate process and decisions.

IL1202.12. demonstrate creative confidence and practice job ready CAD skills and CAM using Autodesk Fusion 360 software.

IL1202.13. develop the CAD design process as applied to prismatic parts.

Evaluation Scheme:

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	10
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

COURSE SYLLABUS:

Introduction to CAD, CAM, and Practical CNC Machining

Autodesk Fusion 360 Foundational Design concepts, CNC and machining basics, Setting up CAM programs, Creating our first CNC program

3-Axis Machining with Autodesk Fusion 360

Basics of 3-axis pocketing, Understanding and Applying Adaptive Toolpaths, Creating Fine Detail Finishing Toolpaths, Creating a Complete CNC Program

Creating Toolpaths for a CNC Lathe

Setting up and Cutting a Profile, Internal and External Grooving Toolpaths, Threading and Chamfering for Turning, CNC Lathe Stock Handling

Multi-Axis CNC Toolpaths

Creating Multi-Axis Positioning Toolpaths, Simultaneous Multi-Axis Toolpaths, Creating Multiple Setups, Creating Multiple Setups for Multiple Machines

Text Books:

1. Prof. Sham Tickoo, “Creo Parametric 2.0 for Designers” CADCIM Technologies; 1st edition -2013.
2. Bruce A. Wilson, “GD&T: Application and Interpretation” Goodheart-Willcox Company, 5th edition -2010.
3. Mikell P. Groover Embory W. Zimmers, “CAD/CAM Computer aided design and manufacturing” Dorling Kindersley India Pvt. Ltd. Pearson Education, 2008

Reference books:

1. Gaurav Verma, Matt Weber, “Creo Parametric 5.0 Black Book “CADCAMCAE Works 3rd edition -2018.
2. Gene Cogorno, “Geometric Dimensioning and Tolerancing for Mechanical Design, A Self-Teaching Guide to ANSI Y 14.5M1982 and ASME Y 14.5M1994 Standards” McGraw-Hill, 2006.

Course Title and Course Code	**Refrigeration and Air Conditioning (ME1205)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech (Semester-VI)**

Course Objective:

The main objective of the course is: -

- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To develop understanding of basic refrigeration processes.
- To develop the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components

Learning Outcomes:

On successful completion of this course, the students should be able to:

- Design an HVAC technology and innovate schematic designs and the goals of HVAC systems
- Asses the principles and practice of thermal comfort
- Design and assess the practical requirement of a Ventilation system
- Develop generalized psychometrics of moist air and apply to HVAC processes
- Assess refrigerant safety as per ASHRAE standards

Prerequisites	**Thermodynamics, Heat Transfer**

Sr. No	Specifications	Marks	Marks (Post COVID)
1	Attendance	0	
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	5	10
5	Theory Exam-I	20	10
6	Theory Exam-II	NIL	
7	Theory Exam-III	30	30
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	15	
12	Project-II	NIL	
13	Project-III	NIL	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	10
16	Course Portfolio	NIL	
Total (100)		**100**	**100**
Evaluation Scheme for Retest		**30**	
1	**Theory Exam-Retest**	**30**	
	Total (30)	**30**	

COURSE SYLLABUS (Theory):

UNIT-I **(10 Lectures)**

Introduction: Concept of heat Engine, heat pump and refrigeration, efficiency and COP, Ideal refrigeration cycle–Reverse Carnot cycle, Unit of refrigeration, refrigeration effect, different types of refrigeration systems. Air refrigeration system, air refrigerator, Bell Coleman cycle, Reverse Brayton cycle–ideal and actual cycle's analysis. Air cycles for aircraft – simple system, Bootstrap system. Regenerative system, Reduced Ambient system, concept of dry air rated temperature.

UNIT-II **(10 Lectures)**

Simple saturated vapor compression refrigeration system, limitation of reversed Carnot cycle with vapor as a refrigerant, pressure- volume, temperature–entropy diagram, pressure–enthalpy diagram, Actual vapor compression cycle and deviation from ideal conditions and their effects on cycle performance, use of tables and charts for solving problems, production of low temperature - compound vapor compression and cascade systems.

UNIT- III **(10 Lectures)**

Vapor absorption refrigeration systems, principles, different refrigerants–absorbent combination, ideal and actual systems, ideal COP of absorption refrigeration systems, solar refrigeration. Refrigerants types, designation of refrigerants, their properties, desirable properties of an ideal refrigerants, selection of refrigerants, impact of refrigerants on global warming and ozone depletion, global warming potential and ozone depletion potential, environmentally friendly refrigerants, secondary refrigerants and its applications.

UNIT- IV **(10 Lectures)**

Refrigeration and Air Conditioning Equipment's: Types of compressors, condensers, expansion devices, evaporators; Cooling and Dehumidifying coils, Temperature sensors, Filters, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories.

Text Books/References: -

1. Refrigeration & air conditioning – Arora, TMGH
2. Basic refrigeration – Dosat, MGH
3. Fundamentals of heat & mass transfer – Dewitt, JW
4. Heat Transfer, J.P. Holman, MGH
5. W.F. Stocker and J.W. Jones "Refrigeration & Air conditioning" TMH, New Delhi.
6. Manohar Prasad "Refrigeration & Air conditioning" Wiley Estern limited, New Delhi.

Course Title and Course Code	**Element of stress analysis (ME1202)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII ME**

Course Objective:
The key objective of this course is to acquaint the students with fundamentals of stress and strain for 1-D, 2-D, and 3-D systems, factors cause failure and theories to avoid failure, transducers to measure the strain and introduction to fracture mechanics.

Learning Outcomes:
On successful completion of this course, the students will be able to:

- Formulate the stress and strain present in any mechanical system.
- Conduct the test to evaluate the behavior of stress and strain
- Conduct experiment to determine 1-D, 2-D, and 3-D stress tensor in a specimen.
- Determine stress and strain using analytical and graphical methods.
- Identify use of transducers for the measurements of strain.
- Analyze the crack propagation and fracture mechanics

Sr. No	Specifications	Marks
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I (Continuous)	25
15	Lab Evaluation-II (Exam)	15
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

Unit I Simple Stresses, Strains & Compound Stresses
Definition/derivation of normal stress, shear stress, and normal strain and shear strain –Stress-strain diagram-Elastic constants –Poisson's ratio –relationship between elastic constants and Poisson's ratio –Hook's law –Strain energy. Introduction to compound stresses, state of stress at a point, General two-dimensional stress system, Principal stresses, and principal planes. Mohr's circle of stresses and Theories of Failure.

Unit II Three-Dimensional Stress and Strain Fields
Introduction to cartesian tensors, Strains: concept of strain, derivation of small strain tensor and compatibility, stress: derivation of Cauchy relations and equilibrium and symmetry equations, airy stress

function, plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Unit III Introduction to Material Modelling
Constitutive equations: generalized Hooke's law, linear elasticity, material symmetry; boundary value problems: concepts of uniqueness and superposition, introduction to plasticity, elastic constitutive models and plastic models, finite element implementation of these models, thermo-elasticity, 2-d contact problems, computational implementation of theories of failure.

Unit IV Stresses and Strain Measurements
Introduction to strain measurement and related instrumentation strain gage-based transducers, Electric Resistance strain gauges, Calibration of strain gauges, Measuring circuits, arrangements of strain gauge elements (rosettes), Practical set-up for measurement of strains, introduction to optical methods in strain measurements, digital image correlation in dynamic/impact conditions.

Unit V Generalized Problems
Thick cylinder under uniform internal and / or external pressure, rotating disks of uniform thickness, solid disks, circular disk with a hole, stress concentration, introductory fracture mechanics, analysis of cracked bodies, numerical implementation of fracture mechanics.
COURSE SYLLABUS (Practical):

12. To evaluate stress strain curve for tension test on a standard Mild Steel specimen
13. To evaluate stress strain curve for compression test on a standard Mild Steel specimen and compare the result with the tension test.
14. To write a MATLAB program to generate LAME'S ellipsoid
15. To write a MATLAB program to generate principle stress, shear stress of a given element and plot the same.
16. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
17. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
18. To develop a CAD model in-order to conduct ANSYS analysis on a given specimen.
19. To study the behavior of stress and strain of a given specimen in ANSYS environment.
20. To study the behavior of deformation of a given specimen in ANSYS environment.
21. To perform Fatigue Test on a given specimen in ANSYS environment.

TextBooks:

1. Timoshenko, S and Goodier, J. N., "Theory of Elasticity", Tata McGraw Hill, New Delhi,3rd edition, 1970
2. Srinath, L. S., "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, 3rd edition, 2010
3. Thomas M. G., Ronald E. S., George. E. M, "Continuum Mechanics for Engineers", 3rdEdition, CRC Press, Boca Raton, 2009

References:

1. Batra, R. C., "Elements of Continuum Mechanics", Reston, 2006.
2. George E. M, Schaum's "Outline of Continuum Mechanics", McGraw-Hill, 1970
3. Dill, Ellis Harold, "Continuum Mechanics: Elasticity, Plasticity, Viscoelasticity", CRC Press, 2006.
4. Sadhu Singh," Theory of Elasticity" Khanna publisher, 4th edition, 2013
5. Timoshenko, Stephen P., and James M. G., "Theory of elastic stability", Courier Corporation, 2nd edition, 2009.

Course Title and Course Code	**POWER PLANT ENGINEERING (ME1203)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VII**

Course Objective:
Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

Learning Outcomes:
On successful completion of this course, the students should be able to:

- Model and compare different boiler's based on high pressure or low pressure
- Draw and construct different power plants based on the working fluid used (diesel, water, etc.)
- Demonstrate various functions of different accessories of boilers
- Critic what would be a sustainable power plant out of all different power plants studies
- Analyze and solve energy and economic related issues in power sectors

Prerequisites		Basics of Physics
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	20
6	Theory Exam-II	NIL
7	Theory Exam-III	40
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT – I

Introduction to power plants and Steam Power Plant: Conventional and Non-Conventional Energy Sources, Load-duration curves and definitions, selection of site for steam power plants, Boiler performance, Rankine cycle, Reheat cycle, Regenerative cycle, Surface condenser performance.

UNIT – II

Diesel Power Plant: Diesel engine performance and operation, Power and mechanical efficiency, m.e.p., s.f.c., volumetric efficiency, Thermal efficiency, relative efficiency, Heat balance.

UNIT – III

Gas Turbine Power Plant: Sterling Cycle, Ericson cycle, Brayton cycle, Advantages and Disadvantages of Gas Turbine Plant, Reheating, Regeneration, Intercooling

UNIT – IV

Solar Energy Power Plant: Solar constant, Solar energy collectors, Photovoltaic power system, solar thermal energy power plant, solar central receiver system, PVsyst project design calculation.

Other Power Plants and economics of power plants: Geo-thermal power plant, OTEC power plant, Tidal wave power plant. Cost of Electric Energy - Fixed and operating Costs - Energy Rates - Types of Tariffs.

COURSE SYLLABUS (Practical):

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To find power output & efficiency of a steam turbine.
5. To find the condenser efficiencies.
6. To study and find volumetric efficiency of a reciprocating air compressor.
7. To conduct variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
8. PVsyst based designing of a solar PV cell project.

Text Books:

13. Nag P.K., "Power plant Engineering", Tata McGraw-Hill, 2008.
14. R. Yadav, "Fundamentals of power plant engineering", Central Publishing House, Allahabad, 2011.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1112	**Industrial Electronics**	**3**	**0**	**2**	**0**	**4**

Course Objectives:

1. Equip students with comprehensive knowledge of power electronics devices and passive components, their practical applications in power electronics
2. Provide the essential numerical background for analyse, design and synthesis of different power conversion circuits and their applications.
3. Equip students with basic experimental and modeling skills for handling problems associated with power electronic circuits and systems

Learning Outcomes:

On successful completion of this course, the students should be able to:

7. Analyze the characteristics of power devices under different load condition
8. Choose appropriate power devices for different requirement of power conversion, and speed control of drives. Also analyse and evaluate their performance
9. Design an electric vehicle charging station with solar PV system.
10. Design battery pack using lithium ion batteries.
11. Use IEC standards for design and analysis of power electronics system.

Assessment Scheme:

Prerequisites: Power Engineering, Electrical Machines, Electronics Devices and Circuits

S. No	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	20
5	Theory Exam-I	Nil
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil

14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
Total		100
Evaluation Scheme for Retest		
1	Theory Exam-III	30
2	Lab Evaluation-II (Examination)	10
	Total	40

Course Syllabi (Theory):

Unit – I: Power Devices: Need for power conversion; Power electronic converters: classifications and scope; Power semiconductor switches: diodes, SCR, GTO and transistors (BJT, MOSFET and IGBT): Ratings, static and dynamic characteristics, drive and switching aid circuits and cooling.

Unit – II: Phase controlled converters: Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, RL and RLE loads, effects of freewheeling diodes, performance parameters evaluation of converters.

Unit – III: DC-DC converters: Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers and switching mode regulators.

Unit – IV: Inverters: Classification, method of commutation & connections, single phase and three phase bridge inverters with R and RL loads, performance parameters evaluation of inverters, design solar power fed electrical vehicle charging station

Unit – IV: Cyclo-converter: Principle of cyclo-converter operation, single phase to single phase Cyclo-converter circuit, Three-phase to single-phase and three-phase to three phase configurations.

Course Syllabi (Practical):

8. Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.
9. Find V-I characteristics of TRIAC and DIAC.
10. Find transfer and output characteristics of MOSFET and IGBT.
11. Study and test firing circuits for SCR-R, RC and UJT firing circuits.
12. Study and test 3-phase diode bridge rectifier with R and RL loads.
13. Study and obtain waveforms of single-phase half wave-controlled rectifier. Study the variation of output voltage with respect to firing angle.
14. Study and test 3-phase diode bridge rectifier with R and RL loads.
15. Study and obtain waveforms of single-phase half-controlled bridge rectifier with R and R-L loads. Study and show the effect of freewheeling diode.
16. Design a solar power fed electrical charging station using data sheet of PV module, solar inverter and electrical vehicle.

17. Study and design a battery pack using Lithium-Ion batteries.

Text Book(s)

6. Bimbhra P.S. “Power Electronics”, Khanna Publisher.
7. Singh M.D. & Khanchandani K.B., “Power Electronics”, Tata McGraw Hill.
8. Sen P.C., “Power Electronics”, Tata McGraw Hill.

Reference Book(s)

1. M. Ramamurthy, “An Introduction to Thyristors and their Applications”, East West Press Pvt Ltd.
2. Mohammad H. Rashid, “Power Electronics Circuits, Devices and Applications”, Prentice Hall of India Pvt. Ltd.

Course Name: Probability Theory and Stochastic Processes (ECE634)	
Hours per Week	**L-T-P:**
Credits	
Students who can take	**2017-2021**
Course Objective: This course aims to introduce basic concepts in probability theory and stochastic processes, with applications in electrical and electronics engineering. Topics covered include probability distributions, random variables, definition, examples and classification of random processes.	

Syllabus

Probability Review and Introduction to Stochastic Processes (SPs): Probability spaces, random variables and probability distribution.

Definition, examples and classification of random processes according to state space and parameter space. Stationary Processes: Weakly stationary and strongly stationary processes, moving average and auto regressive processes.

Discrete-time Markov Chains (DTMCs): Transition probability matrix, Chapman-Kolmogorov equations; n-step transition and limiting probabilities, ergodicity, stationary distribution, random walk and gambler's ruin problem, applications of DTMCs.

Continuous-time Markov Chains (CTMCs): Kolmogorov differential equations for CTMCs, infinitesimal generator, Poisson and birth-death processes, stochastic Petri net, applications to queueing theory and communication networks.

Martingales: Conditional expectations, definition and examples of martingales, applications. Brownian Motion: Wiener process as a limit of random walk;
process derived from Brownian motion, stochastic differential equation, stochastic integral equation, Ito formula, Some important SDEs and their solutions.

Renewal Processes: Renewal function and its properties, renewal theorems, cost/rewards associated with renewals, Markov renewal and regenerative processes, non Markovian
queues, applications of Markov regenerative processes.

Activities Related to Skill Development and Employability

Students work in practical applications like:

1. Communication network model
2. Digital processing of voice, audio, images, etc
3. Control system modelling

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ECE523	Advanced Microcontrollers	3	1	2	1	3

Evaluation Scheme (Theory)					Evaluation Scheme (Practical)			
Mid Term Test – I	Mid Term Test - II	End Term Test	Class Participation Additional Continuous Evaluation*	Total Marks **	Mid Term Test - I	End Ter m Test	Class Participation Additional Continuous Evaluation*	Total Marks **
20	20	50	10	100	20	50	30	100

Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture.

Cortex-M3 Basics: Registers, General Purpose Registers, StackPointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Cortex-M3Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

CORTEX EXCEPTION HANDLING AND INTERRUPTS Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency.

CORTEX-M3/M4 PROGRAMMING Cortex-M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.

CORTEX-M3/M4 DEVELOPMENT AND DEBUGGING TOOLS

STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development & Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyser.

Text books

1. Programming ARM CORTEX-M4 TMC 123G with C by Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi and Sepehr Naimi.
2. Steve Furber, “ARM System-on-Chip Architecture”, 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403, 2015

Activities Related to Skill Development and Employability

Quizzes/Assignments/ Practical Records/Mock Interviews/others were given to students. Students are also motivated to attend the workshop, take part in the various competition, hachthon etc to make them enable to compete with the external world.

<table>
<tr><td colspan="2">Course Name: Digital Control Systems (ECE632)</td></tr>
<tr><td>Hours per Week</td><td>L-T-P:</td></tr>
<tr><td>Credits</td><td></td></tr>
<tr><td>Students who can take</td><td>2017-2021</td></tr>
<tr><td colspan="2">Course Objective: This course introduces the fundamental concepts, principles and application of digital control system analysis and design. The topics cover classical control design methods as well as the modern techniques.</td></tr>
<tr><td colspan="2">Learning Outcomes: Upon the successful completion of the course, students will be able to:
Represent discrete time systems under the form of z-domain transfer functions and state-space models.
Analyze stability, transient response and steady state behavior of linear discrete-time systems, analytically and numerically.
Design digital control systems using transform techniques and state-space methods.
Describe and test controllability and observability of linear systems.</td></tr>
</table>

Syllabus

- Introduction to digital control
- Discrete time systems
- Modeling of digital controls systems
- Stability of digital control systems
- Digital control systems design
- State space representation of digital control systems
- Properties of discrete state-space models
- State feedback digital control
- Proportional, derivative and integral control
- Introduction to optimal digital control
- Practical issues

Activities Related to Skill Development and Employability

Students work in practical applications like:

1. Control of electrical and mechanical systems
2. PLC programming
3. Control loop design and maintenance
4. Motion control and robotics

Certificates

Preparation for ISA Certified Automation Professional® (CAP®) Certification Program

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ECE606	**FPGA Based Signal Processing**	**3**	**0**	**2**	**0**	**3**

Course Objectives: To impart advanced level knowledge on design and implementation of VLSI DSP Systems

Syllabus:

EEG Signal Processing- Design and Implementation of FIR Filters, on board Programmable preamplifier, ADC and DAC on FPGA. Timing simulation of filter, S/N improvement testing.

Block Diagram of a Software Radio. Digital Down Converters and Demodulators. Universal Modulator and Demodulator Using CORDIC. Incoherent Demodulation - Digital Approach for I and Q Generation, Special Sampling Schemes. CIC Filters. Residue Number System and High-Speed Filters Using RNS. Down Conversion Using Discrete Hilbert Transform. Under sampling Receivers, Coherent Demodulation Schemes.

Speech Coding- Speech Apparatus. Models of Vocal Tract. Speech Coding Using Linear Prediction. CELP Coder. An Overview of Waveform Coding. Vocoders. Vocoder Attributes. Block Diagrams of Encoders and Decoders of G723.1, G726, G727, G728 and G729.

Projects:

1 ECG signal processing for improved S/N and digitization for communication.
2. Brief idea about software radio.
3. Study of Speech Coding Using Linear Prediction.

Text Books

1. J. H. Reed, Software Radio, Pearson, 2002.
2. U. Meyer – Baese, Digital Signal Processing with FPGAs, Springer, 2004

Course Title and Course Code	Power Electronics Applications in Renewable Energy Systems (ECE633)
Hours per Week	L T P: 3 0 0
Credits	3
Students who can take	B. Tech Semester-VI

Course Description:
Power electronic circuits are an essential component of renewable energy sources including wind turbines, photovoltaic and energy storage systems. This course covers the design and implementation of power electronic devices for off-grid and grid connected renewable energy systems. Power quality issues in renewable energy systems are also addressed.

Syllabus (Theory)

UNIT I

Introduction Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission), Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II

Electrical Machines for Renewable Energy Conversion Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III

Power Converters Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode), Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers, AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV

Analysis of Wind and PV Systems, Standalone operation of fixed and variable speed wind energy conversion systems and solar system, Grid connection Issues, Grid integrated PMSG and SCIG Based WECSGrid Integrated solar system.

UNIT V

Hybrid Renewable Energy System Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Wind, Maximum Power Point Tracking (MPPT), Power Quality Issues of Grid Interfacing Grid requirements for interconnections, transients developed due to connections/ disconnections, voltage flicker, remedial measures for voltage flickers.

Text book(s)

1. Rashid M. H, “Power electronics”, Pearson education.
2. Rai. G.D,”Non-conventional energy sources”, Khanna publication.
3. Rai. G.D,” Solar energy utilization”, Khanna publication.

Reference book(s)

1. Gray, L. Johnson “Wind energy system”, prentice hall.
2. B.H.Khan, “Non-conventional Energy sources”, TMH.
3. B. K. Bose, “Modern Power Electronics and AC Drives” Prentice Hall.

E-resource(s)

NCTEL: http://www.nitttrchd.ac.in/sitenew1/nctel/electrical.php

Activities Related to Skill Development and Employability

- Quizzes/Assignments/Hands-on Activities/Mock Interviews are given to students.
- Students are motivated to attend the workshops and write research papers.

Industrial Visit

- Industrial Visit of 220 kV GSS Mahindra SEZ
- Visit of 400 kWp Solar plant and 33/0.4 kV substation at JKLU campus.

Projects

1. Design of Hybrid energy system

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>ECE635</td><td>Security in IoT Systems</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Objectives: This course aims to sensitize the students towards vulnerabilities in IoT networks and help them propose solutions for cyber defense of IoT networks.</td></tr>
<tr><td colspan="7">Syllabus:
General Overview: IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle
Crypto foundations: Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms.
Blockchains: Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, scripts and smart contracts, wallets: hot and cold storage, anonymity, altcoins. •
Credential management for connected devices: Security credential management system (SCMS), Vehicle Based Security System (VBSS), PKI design, certification provisioning, pseudonyms (privacy-by design), misbehavior detection, revocation.</td></tr>
<tr><td colspan="7">Project: To design a VPN for secure IoT Network for five IoT devices on public network using Cisco Packet Tracer.</td></tr>
</table>

Text Books

1. B. Rusell and D. Van Duren, “Practical Internet of Things Security,” Packt Publishing, 2016
2. Blockchain Applications-A Handson Approach-Arshdeep Bagha, Vijay Madisetti, 2017.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>ECE524</td><td>Digital VLSI Technology</td><td>2</td><td>0</td><td>4</td><td>0</td><td>3</td></tr>
</table>

Course Objectives: This course involves basic theories and techniques of digital VLSI design in CMOS technology. In this course, students study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies.

Course Outcomes:

On successful completion of this course, the students will be able to

1. Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
2. Create models and perform analysis of CMOS circuits.
3. Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Design VLSI layout having a set of objective criteria and design constraints.
5. Design static CMOS combinational and sequential logic at the transistor level, including mask layout.
6. Estimate and optimize combinational circuit delay using RC delay models and logical effort
7. Design functional units including adders, multipliers, ROMs, SRAMs.

Syllabus: Introduction to VLSI Systems, CMOS logic, fabrication and layout, MOS Transistor theory, Layout Design Rules, Circuit characterization and performance estimation, Circuit Simulation, Combinational and sequential circuit design, Memory system design, Design methodology and tools.

Projects: Implementation of FSM models for Elevator, Automatic Washing machine, Traffic Light controller, ATM machine**.**

Text Books: VHDL primer by Jayaram Bhasker

Course Title and Course Code	Energy Audit (EE626)
Hours per Week	L T P: 3 0 0
Credits	3
Students who can take	B. Tech Semester-VI
Course Description: Energy Audit helps to map the flow of energy (in its various forms) across the value chain, highlighting areas for interventions. This course is designed to sensitize students on the mechanism of energy audit and the technologies/ tools typically employed to undertake an audit exercise, supported by case studies & site visits.	

Syllabus (Theory)

UNIT I

Energy Scenario:

Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy sonservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features.

UNIT II

Energy Audit:

Energy Audit Concepts: Need of Energy audit, Types of energy audit, Energy management approach, understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Duties and responsibilities of energy auditors, Energy audit instruments, procedures and techniques.

UNIT III

Energy Conservation in Electrical Systems:

Components of billing, types of tariff, HT and LT supply, Transformers, cable selection, power factor improvement, capacitors, harmonics, electric motors, efficiency, energy efficient motors, variable speed drives, lighting, types, efficacy, LED.

UNIT IV

Energy Auidt and Energy Economics

Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.

UNIT V

Energy Action Planning:

Key elements, field analysis, Energy policy purpose, perspective, contents, formulation, ratification, location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability. Motivation of employees: Information system, designing barriers, strategies, marketing and communicating, training and planning.

Reference book(s)

1. Sonal Desai, Handbook of Energy Audit, McGraw Hill Education (India) Private Limited New Delhi.
2. Albert Thumann, Terry Niehus, William J. Younger, “Handbook of Energy Audits” by

The Fairmont Press, Inc.
3. Guide book for National Certification Examination for Energy Managers and Energy Auditors by Bureau of Energy Efficiency, New Delhi.
4. Website of Bureau of Energy Efficiency (https://beeindia.gov.in/)

Activities Related to Skill Development and Employability

- Quizzes/Assignments/Hands-on Activities/Mock Interviews are given to students.
- Students are motivated to attend the workshops.

Industrial Visit

- Industrial Visit of JCB Jaipur plant.

Projects

- Energy audit of JKLU buildings.

Course Title and Course Code	**Energy Management Systems and SCADA** (EE525)
Hours per Week	L T P: 3 0 0
Credits	3
Students who can take	B. Tech Semester-V

Course Description:
The course provides an introduction to the role of Computers and Communication in Electrical Power Engineering. Energy Management Systems (EMS) and Supervisory Control and Data Acquisition (SCADA) are strongly linked and associated with each other. This course provides an introductory course material for power system automation and recent advances in technological aspects of computers and communications in networking.

Syllabus (Theory)

UNIT I: Energy Management System

Introduction to EMS, Objectives, Evolution of EMS, Evolution of SCADA, Function and Benefits of EMS, EMS Architecture, Practical EMS, Working of EMS, Power System Security: Introduction, Static Security Assessment, Operating states of Power System. Real Time or Online Application: Control Function, Protection Function, Operating States of Power System

UNIT II: SCADA

Purpose and necessity, general structure, data acquisition, transmission & monitoring. general power system hierarchical Structure. Overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels: cables, telephone lines, power line carrier, microwaves, fiber optical channels and satellites.

UNIT III: SCADA Architecture and applications

SCADA Architecture Various SCADA architectures, advantages and disadvantages of each System, single unified standard architecture -IEC 61850.

Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries: oil, gas and water, Case studies, Implementation, Simulation Exercises.

UNIT IV: Economic Analysis and System Energy Management

Important concepts in an economic analysis, Electricity tariff, Electrical Load Management and Maximum Demand Control, Systems and equipment, Electric motors, Transformers, Capacitors: power factor and effect of harmonics on power quality, Energy efficiency analysis on electrical power system, motor and transformer.

UNIT V: Power System Automation

Benefits of Power System Automation, Power System Automation, Architecture for Power System Automation, Classification of Power system Automation, Implementation of Power System Automation and Protection Using SCADA, SCADA Based Model for Automation and Digital Protection.

References:

1. P. Giridhar Kini and Ramesh C. Bansal, "Energy Management System" InTech, Croatia.
2. Craig B. Smith and Kelly E. Parmenter, "Energy Management Principles: Applications, Benefits,
 Savings" Elsevier Inc.
3. Marvin T. Howell, "Effective Implementation of an ISO 50001 Energy Management

System (EnMS)” ASQ Quality Press, Milwaukee, Wisconsin.
4. Stuart A. Boyer, “SCADA: Supervisoty Control and Data Acquisition” ISA- The Instrumentation, Systems and Automation Society.

<u>Activities Related to Skill Development and Employability</u>

- Quizzes/Assignments/Hands-on Activities/Mock Interviews are given to students.
- Students are motivated to attend the workshops.

Industrial Visit

- Industrial Visit of 220 GSS Bhankrota Jaipur.

Projects

- Case study on power system automation using SCADA.

CSESP302 Linux System Administration
LTP- o-o-4
Credits: 2
Syllabus

Unit-I: Access the command line: Log in to a Linux system and run simple commands using the shell, manage files from the command line: Copy, move, create, delete, and organize files from the bash shell prompt. Get help in Red Hat Enterprise Linux: Resolve problems by using online help systems and Red Hat support utilities.

Unit-II: Create, view, and edit text files: Create, view, and edit text files from command output or in an editor. Manage local Linux users and groups: Manage local Linux users and groups, and administer local password policies. Control access to files with Linux file system permissions: Set Linux file system permissions on files and interpret the security effects of different permission settings.

Unit-III: Monitor and manage Linux processes: Obtain information about the system, and control processes running on it, Control services and daemons: Control and monitor network services and system daemons using system, Configure and secure OpenSSH service: Access and provide access to the command line on remote systems securely using OpenSSH.

Unit-IV: Analyze and store logs: Locate and accurately interpret relevant system log files for troubleshooting purposes, Manage Red Hat Enterprise Linux networking: Configure basic IPv4 networking on Red Hat Enterprise Linux systems, Archive and copy files between systems: Archive files and copy them from one system to another.

Unit-V: Install and update software packages: Download, install, update, and manage software packages from Red Hat and yum package repositories. Access Linux file systems: Access and inspect existing file systems on a Red Hat Enterprise Linux system, Use virtualized systems: Create and use Red Hat Enterprise Linux virtual machines with KVM and libvirt.

Text/Reference Book:

1. Course Material provided by REDHAT.

Course code	Course Title	Teaching Scheme			
		L	**T**	**P**	**Credits**
PR1106	**Apprenticeship**				**2**

Evaluation Scheme

S. No.	Evaluation Component		Marks (100) (Weightage %)
1	**External Supervisor**	**Day to Day task Record**	**30**
		Report Content and Presentation	**20**
2	**Faculty Supervisor**	**Reporting Activity Fortnightly**	**20**
		Presentation, Viv, Report	**30**

Syllabus:

This course is additional internship pursued by student at an organization/university. The objective of this course is to provide the students, an opportunity to work on live projects of corporate world in various fields. During this course, they will work on real world applications of their curricula through organizational function of their choice. The students are expected to be involved directly in problem solving efforts of specific interest to the host organization.