LIST OF OPEN ELECTIVES
(Applicable for the Batches Admitted from 2020-21)

For All B.Tech Programmes under R-20

NEC
NARASARAOPETA
ENGINEERING COLLEGE

NEC NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

Kotappakonda Road, Yellamanda (Post), Narasaropet – 522601, Palnadu District, AP
Approved by AICTE, New Delhi & Permanently affiliated to JNTUK, Kakinada, Code: 47, NIRF Ranking in 251 – 300 Band
Accredited by NBA (CSE, ECE) & NAAC 'A+' Grade, ISO 9001: 2015 Certified Institution
Phone: 08647-239904 **Website: www.nrtec.in**

LIST OF OPEN ELECTIVES OFFERED BY ALL DEPARTMENTS

OPEN ELECTIVE-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Disaster Management	CE	R20CC1OE01	3	0	0	3
2	Green Technology	CE	R20CC1OE02	3	0	0	3
3	Micro Electro Mechanical System	EEE	R20CC1OE03	3	0	0	3
4	Fundamentals of Electrical Engineering	EEE	R20CC1OE04	3	0	0	3
5	Rapid Prototyping & 3D Printing (Other than ME)	ME	R20CC2OE05	3	0	0	3
6	Operations Research	ME	R20CC2OE06	3	0	0	3
7	Principles of Signals, Systems & Communications (Other than ECE)	ECE	R20CC1OE08	3	0	0	3
8	Medical Electronics	ECE	R20CC1OE08	3	0	0	3
9	DBMS (Other Than CSE)	CSE	R20CC1OE09	3	0	0	3
10	Web Development Using Mean Stack Tech	CSE	R20CC1OE11	3	0	0	3
11	Front End UI and Frame Work	IT	R20CC1OE10	3	0	0	3
12	Web Development Using Mean Stack Tech	IT	R20CC1OE12	3	0	0	3
13	Financial Institutions, Markets and Services	MBA	R20CC1OE13	3	0	0	3
14	Human Resource Practices	MBA	R20CC1OE14	3	0	0	3
15	OOP Through JAVA	AI	R20CC1OE15	3	0	0	3
16	Computer Organization	AI	R20CC1OE16	3	0	0	3

OPEN ELECTIVE-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Remote Sensing And GIS	CE	R20CC2OE01	3	0	0	3
2	Traffic Safety	CE	R20CC2OE02	3	0	0	3
3	Hybrid Electric Vehicle	EEE	R20CC2OE03	3	0	0	3
4	Energy Audit and Conservation	EEE	R20CC2OE04	3	0	0	3
5	Industrial Engineering & Management (Other than ME)	ME	R20CC2OE05	3	0	0	3
6	Industrial Robotics (Other than ME)	ME	R20CC2OE06	3	0	0	3
7	Fundamentals of Image Processing (Other than ECE)	ECE	R20CC2OE07	3	0	0	3
8	Global Positioning System(GPS)	ECE	R20CC2OE08	3	0	0	3
9	Artificial Intelligence	CSE	R20CC2OE09	3	0	0	3
10	OOPS through JAVA	CSE	R20CC2OE10	3	0	0	3
11	Introduction to AI	IT	R20CC2OE11	3	0	0	3
12	OOP Through JAVA	IT	R20CC2OE12	3	0	0	3
13	Digital Marketing	MBA	R20CC2OE13	3	0	0	3
14	Personal Finance Planning	MBA	R20CC2OE14	3	0	0	3
15	Database Management Systems	AI	R20CC2OE15	3	0	0	3
16	Cloud Computing	AI	R20CC2OE16	3	0	0	3

OPEN ELECTIVE-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Railway, Airport & Harbour Engineering	CE	R20CC3OE01	3	0	0	3
2	Low Cost Housing	CE	R20CC3OE02	3	0	0	3
3	Concept of Smart Grid Technology	EEE	R20CC3OE03	3	0	0	3
4	Industrial Automation	EEE	R20CC3OE04	3	0	0	3
5	Automotive Vehicles	ME	R20CC3OE05	3	0	0	3
6	Nano Technology	ME	R20CC3OE06	3	0	0	3
7	Introduction to Micro Processors & Micro Controllers(Other than ECE)	ECE	R20CC3OE07	3	0	0	3
8	Nano Electronics	ECE	R20CC3OE08	3	0	0	3
9	Cloud Computing	CSE	R20CC3OE09	3	0	0	3
10	Block Chain Technologies	CSE	R20CC3OE10	3	0	0	3
11	Digital Marketing	IT	R20CC3OE11	3	0	0	3
12	Augmented Reality	IT	R20CC3OE12	3	0	0	3
13	Performance Management	MBA	R20CC3OE13	3	0	0	3
14	Services Marketing	MBA	R20CC3OE14	3	0	0	3
15	Block Chain Technologies	AI	R20CC3OE15	3	0	0	3
16	Human Computer Interaction	AI	R20CC3OE16	3	0	0	3

OPEN ELECTIVE-IV

S.No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Environmental Pollution & Control	CE	R20CC4OE01	3	0	0	3
2	Construction Technology and Management	CE	R20CC4OE02	3	0	0	3
3	Non-Conventional Energy Resources	EEE	R20CC4OE03	3	0	0	3
4	Electrical Safety	EEE	R20CC4OE04	3	0	0	3
5	Pneumatics & Hydraulic Automation	ME	R20CC4OE05	3	0	0	3
6	Mechatronics	ME	R20CC4OE06	3	0	0	3
7	Introduction to Embedded Systems (Other than ECE	ECE	R20CC4OE07	3	0	0	3
8	Embedded and Real time Operating System	ECE	R20CC4OE08	3	0	0	3
9	Cyber Security	CSE	R20CC4OE09	3	0	0	3
10	Ethical Hacking	CSE	R20CC4OE010	3	0	0	3
11	Ethical Hacking	IT	R20CC4OE011	3	0	0	3
12	E-Commerce	IT	R20CC4OE012	3	0	0	3
13	Quality Management	MBA	R20CC4OE013	3	0	0	3
14	Logistics and Supply Chain Management	MBA	R20CC4OE014	3	0	0	3
15	DevOps	AI	R20CC4OE015	3	0	0	3
16	E-Commerce	AI	R20CC4OE016	3	0	0	3

CIVIL

OPEN ELECTIVE/JOB ORIENTED COURSE-I										
S.NO	**CODE**	**SUBJECT**	**CAT. CODE**	**INTERNAL**	**EXTERNAL**	**TOTAL MARKS**	**L**	**T**	**P**	**CREDITS**
1	R20CC1OE01	1. Disaster Management	OE	30	70	100	4	0	0	4
2	R20CC0E02	2. Green Technology	OE	30	70	100	4	0	0	4
OPEN ELECTIVE/JOB ORIENTED COURSE-II										
3	R20CC2OE01	3. Remote Sensing And Gis	OE	30	70	100	4	0	0	4
4	R20CC20E02	Traffic Safety	OE	30	70	100	4	0	0	4
OPEN ELECTIVE/JOB ORIENTED COURSE-III										
5	R20CC30E01	5. Railway, Airport & Harbor Engineering	OE	30	70	100	4	0	0	4
6	R20CC30E02	6. Low Cost Housing	OE	30	70	100	4	0	0	4
OPEN ELECTIVE/JOB ORIENTED COURSE-IV										
7	R20CC40E01	Environmental Pollution & Control	OE	30	70	100	4	0	0	4
8	R20CC4OE02	. Construction Technology And Management	OE	30	70	100	4	0	0	4

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC1OE01	3	0	0	30	70	100	3
DISASTER MANAGEMENT							

COURSE OBJECTIVES:

The subject provides different disasters, tools and methods for disaster management

COURSE OUTCOMES:

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

CO 1: Understanding Disasters, man-made Hazards and Vulnerabilities

CO 2: Understanding disaster management mechanism

CO 3: Understanding capacity building concepts

CO 4: Understanding coping Strategies

CO 5: Understanding planning of disaster managements

UNIT – I Understanding Disaster:

Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena an Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

UNIT – II Disaster Management Mechanism

Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

UNIT – III Capacity Building:

Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

UNIT – IV Coping with Disaster:

Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT – V Planning for disaster management:

Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

REFERENCE BOOKS:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC0E02	3	0	0	30	70	100	3
GREEN TECHNOLOGY							

COURSE OBJECTIVES:

Objective of this course is:

- To present different concepts of green technologies.
- To acquire principles of Energy efficient technologies.
- To impart knowledge on the methods of reducing CO2 levels in atmosphere.
- To gain knowledge of the importance of life cycle assessment
- To learn the importance of green fuels and its impact on environment.

COURSE OUTCOMES

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

CO 1: Enlist different concepts of green technologies in a project

CO 2: Understand the principles of Energy efficient technologies

CO 3: Estimate the carbon credits of various activities

CO 4: Identify the importance of life cycle assessment

CO 5: Recognize the benefits of green fuels with respect to sustainable development.

SYLLABUS:

UNIT- I

Introduction: Green Technology – definition- Importance – Historical evolution – advantages and disadvantages of green technologies-factors affecting green technologies- Role of Industry, Government and Institutions – Industrial Ecology – role of industrial ecology in green echnology. Cleaner Production (CP): Definition – Importance – Historical evolution - Principles of Cleaner Production–Benefits–Promotion Barriers – Role of Industry,

UNIT- II

Cleaner Production Project Development and Implementation:Government and Institutions – clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste, case studies.

Overview of CP Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives - Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress- ISO 14000.

UNIT- III

Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labelling.

UNIT -IV

Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices, their principles, working and application.

UNIT- V

Green Fuels – Definition-benefits and challenges – comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts- public policies and market-driven initiatives.

Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context; tidal and geothermal energy.

TEXT BOOKS:

1. Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
2. 'Cleaner Production Audit' by Prasad Modak, C.Visvanathan and Mandar Parasnis (1995), Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok
3. 'Non-conventional Energy Sources' by Rai G.D.

REFERENCE BOOKS:

1. 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.
2. 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
3. 'Solar Energy' The Solar Hydrogen Alternative' by Bokris J.O.
4. 'Solar Energy' by Sukhatme S.P.
5. 'Waste Energy Utilization Technology' by Kiang Y. H.

III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC2OE01	2	0	2	30	70	100	3
REMOTE SENSING AND GIS							

COURSE OBJECTIVES:

The course is designed to

- Introduce the basic principles of Remote Sensing and GIS techniques.
- learn various types of sensors and platforms
- learn concepts of visual and digital image analyses
- understand the principles of spatial analysis
- appreciate application of RS and GIS to Civil Engineering

COURSE OUTCOMES

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

CO 1: Be familiar with ground, air and satellite based sensor platforms.

CO 2: interpret the aerial photographs and satellite imageries

CO 3: create and input spatial data for GIS application

CO 4: apply RS and GIS concepts in general

CO 5: apply RS and GIS concepts in hydrology

UNIT – I

Introduction to Remote sensing: Basic concepts of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere, energy interaction with the earth surfaces, characteristics of remote sensing systems, types of resolutions - advantages & limitations**Sensors and platforms:** Introduction, types of sensors, airborne remote sensing, space borne remote sensing, image data characteristics, digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, IRS, LANDSAT, SPOT & Recent satellite.

UNIT – II Image analysis:

Introduction, elements of visual interpretations, digital image processing- image pre- processing, image enhancement, image classification, supervised classification, unsupervised classification. : Overlay function-vector overlay operations; raster overlay operations, network analysis.

UNIT – III Geographic Information System:

Basic Principles, components, application areas of GIS, map projections.

Data entry and preparation: spatial data structures, raster and vector data formats, data inputs, data manipulation, data retrieval, data analysis and data display.

UNIT – IV RS and GIS applications General:

Land cover and land use, agriculture, forestry, geology, geomorphology, urban & transportation applications,

UNIT – V Application to Hydrology and Water Resources:

Flood zoning and mapping, groundwater prospects, groundwater quality monitoring and potential recharge zones, watershed management.

TEXT BOOKS:

1. Bhatta B (2008), 'Remote sensing and GIS', Oxford University Press
2. Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013) 'Remote Sensing and Image Interpretation', Wiley India Pvt. Ltd., New Delhi
3. Schowenger, R. A (2006) 'Remote Sensing' Elsevier publishers.
4. 'Fundamentals of Remote Sensing' by George Joseph, Universities Press, 2013.
5. 'Fundamentals of Geographic Information Systems' by Demers, M.N, Wiley India Pvt. Ltd, 2013.

REFERENCE BOOKS:

1. 'Remote Sensing and its Applications' by Narayan LRA, Universities Press, 2012.
2. 'Concepts and Techniques of Geographical Information System' by Chor Pang Lo and A K W Yeung, Prentice Hall (India), 2006

III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC20E02	2	0	2	30	70	100	3
TRAFFIC SAFETY							

COURSE OBJECTIVES:

- This module on the fundamentals of traffic engg. & some of the statistical methods to analyse the traffic safety.
- The accident interrogations and risk involved with measures to identify the causes are dealt.
- The role of road safety in planning the urban infrastructures design is discussed.
- Various mitigation measures to prevent the road accidents are dealt.

COURSE OUTCOMES:

The student is able to

CO 1: To understand fundamentals of Traffic Engg.

CO 2: To investigate and determine the collective factors & remedies of accident involved.

CO 3: To design and plan various road geometrics.

CO 4: To manage the traffic system from road safety point of view.

UNIT I Fundamentals of Traffic Engineering:

Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Traffic Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT II Accident Investigations and Risk Management:

Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible

Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction.

UNIT III Road Safety in Planning and Geometric Design:

Vehicle And Human Characteristics, Road Design and Road Equipments, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT IV Role of Urban infrastructure design in safety:

Geometric Design of Roads; Design of Horizontal and Vertical Elements, Junctions, At Grade and Grade Separated Intersections, Road Safety in Urban Transport, Sustainable Modes and their safet

UNIT V Mitigation Measures:

Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety; Safety in urban areas; Public transport and safety; Road safety policy making, Stakeholders involvement; Road safety law, Road safety audit

TEXT BOOKS:

1. Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE, 1999.
2. Towards Safe Roads in Developing country, TRL – ODA, 2004.
3. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
4. Fundamentals of Traffic Engineering, Richardo G Sigua

REFERENCE BOOKS:

1. Athelstan Popkess, Traffic Control and Road Accident Prevention, Chapman and Hall, 1997 (Digitized 2008)
2. Handbook of Road Safety measures, second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson
3. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002).
4. Geetam Tiwari and Dinesh Mohan, Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safer, CRC Press, 2016
5. Fundamentals of Transportation Engineering – C.S. Papacostas, Prentice Hall India.

IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC30E01	2	0	2	30	70	100	3
RAILWAY, AIRPORT & HARBOR ENGINEERING							

COURSE OBJECTIVES:

- To understand the role of railways in transportation.
- To understand various parts of a railway track. And Introduction to geometric design of a railway section.
- To emphasize on various requirements of stations
- Present the concept airport planning, various obstruction runway and structural design of airport pavement.
- Emphasize on various facilities of a harbor and port and various controlling devices of a harbour.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

CO 1: Judge and identify proper material and component for a railway track

CO 2: Design various component of a track.

CO 3: State importance of a railway station.

CO 4: Plan various amenities of an airport planning and runway design.

CO 5: Describe various features of a harbor and a port to enable for proper design and maintenance of various amenities

UNIT I Railway Engineering:

Introduction Role of railways in transportation; Comparison of railway and highway transportation; Development of railway systems with particular reference to India; Classification of railways.

Railway Track: Permanent way: Gauges in Railway track, Railway track cross – sections; Coning of wheels.

Rails & Rail Joints: Functions of rails; Requirements of rails; Types of rails sections; Standard rail sections; Length of rails; Rail failures; Wear on rails. Requirements of an ideal joint; Types of rail joints; Welding of rails.

Sleepers: Functions of sleepers; Requirements of sleepers; Classification of Sleepers – Timber sleepers, Metal sleepers & Concrete sleepers; Comparison of different types of sleepers.

UNIT II Fish Plates: Fish plates, section of fish plates, and failure of fish plates.

Geometric Design Of Track: Necessity; Gradients & Gradient Compensation; Elements of horizontal alignment; Super elevation; Cant deficiency and cant excess; Negative Super elevation; Length of Transition Curve, Length of vertical curve.

Points And Crossings: Functions of components of turnout; Crossings.

UNIT III Ballast: Functions and requirements of ballast; Types of ballast; Renewal of ballast

Stations And Yards: Site selection for railway station; Requirements of railway station; Classifications; Station yards; Level crossing.

Signalling: Objects of signaling; Classification of signals; Controlling- absolute block system. Standards of inter locking

UNIT IV AIRPORT PLANNING AND DESIGN: IntroductionDevelopment of air transportation system with particular reference to India; Aeroplane components; Air–craft characteristics.

Airport planning and layout: Selection of site; Apron; Hanger; Typical airport layouts; Airport marking; Airport lighting; Drainage systems.

Airport Obstruction: Zoning laws; Classification of obstructions; imaginary surfaces; Approach zone; Turning zone.

Runway Design: Runway orientation; Basic runway length; Corrections for elevation; Temperature and gradient;Runway geometric design.

Specifications for Structural Design of Airport Pavements: Design factors methods for flexible and rigid pavements; LCN system of pavement design.

UNIT V :DOCKS AND HARBOUR ENGINEERING: Introduction Types of water transportation; Economics and advantages of water transportation.

Planning and Design Of Port Facilities: General layout and design considerations; Pier and wharf structures; Fender systems; Transit sheds and Apron; Container ports; Docks; Dredging; Light Houses.

TEXT BOOK(s):

1. Railway Engineering by S.C.Saxena and S.Arora , Dhanpat Rai & sons.
2. Airport Planning and Design by S. K. Khanna & M. G. Arora, 6th Edition, Nemchand & Bros, 1999.
3. Dock, harbour engineering by rangawala

REFERENCE BOOK(s):

1. Railway Engineering by M.M.Agarwal and Satish Chandra, Oxford University Press, 2007.
2. Airport Engineering by G.V.Rao; Tata Mc Graw Hill, 1991

IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC30E02	2	0	2	30	70	100	3
LOW COST HOUSING							

COURSE OBJECTIVES:

To understand about the Low cost housing techniques adopted in civil engineering field.

COURSE OUTCOMES:

CO 1: Understand about the Housing scenario and Housing finance concepts.

CO 2: Understand about the Land Use and Physical Planning for Housing and Housing the Urban Poor

CO 3: Understand about the Development and Adopt on of Low-Cost Housing Technology

CO 4: Understand about the Low Cost Infrastructure Services and Rural Housing

CO 5: Understand about the Housing in Disaster Prone Areas

UNIT – I Housing Scenario

Status of urban housing- Status of Rural Housing,

Housing Finance: Introducing- Existing finance system in India- Government role as facilitator Status at Rural Housing Finance- Impedimental in housing finance and related issues

UNIT- II Land Use and Physical Planning for Housing:

Planning of urban land- Urban land ceiling and regulation act- Effectincey of building bye laws - Residential Densities

Housing the Urban Poor: Living conditions in slums- Approaches and strategies for housing urban poor

UNIT-III Development and Adopt on of Low-Cost Housing Technology

Adoption of innovative cost effective construction techniques- Adoption of precast elements in partial prefabrication- Adopting of total prefabrication of mass housing in India- General remarks on pre cast rooting/flooring systems- Economical wall system- Single Brick thick loading bearing wall- 19cm

thick load bearing masonry walls- Half brick thick load bearing wall-Fly ash, gypsum thick for masonry- Stone Block masonry- Adoption of precast R.C. plank and join system for roof/floor in the building

Alternative Building Materials for Low Cost Housing: Substitute for scarce materials- Ferro cement- Gypsum boards- Timber substitutions- Industrial wastes- Agricultural wastes

UNIT- IV Low Cost Infrastructure Services

Present status- Technological options- Low cost sanitation's- Domestic wall- Water supply energy **Rural Housing:** Introduction- traditional practice of rural housing continuous- Mud Housing technology- Mud roofs- Characteristics of mud- Fire resistant treatment for thatched roof- Soil stabilization- Rural Housing programs

UNIT-V Housing in Disaster Prone Areas

Earthquake- Damages to houses- Traditional Houses in disaster prone areas Type of Damages and Railways of non-engineered buildings- Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions- Requirements of structural safety of thin precast roofing units against - Earthquake forces- Status of R&D in earthquake strengthening measures- Floods- cyclone- future safety

TEXT BOOKS:

1. Building materials for low –income houses – International council for building research studies and documentation.
2. Modern trends in housing in development countries – A.G. Madhava Rao, D.S. Ramachnadra Murthy & G. Annamalai
3. Light weight concrete- Academic Kiado- Rudhai. G – Publishing home of Hungarian Academy of Sciences 1963.

REFERENCE BOOKS:

1. Building Systems for Low Income Housing, Ashok Kumar Jain; Management Publishing House, 1992
2. Hand book of low-cost housing - by A. K. Lal – Newage international publishers.
3. Low Cost Housing in Developing Countries, Guru Charan Mathur; For Centre for Science & Technology of the Non-Aligned and Other Developing Countries, Oxford & IBH Publishing Company, 1993

IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
CODE: R20CC40E01	2	0	2	30	70	100	3
ENVIRONMENTAL POLLUTION & CONTROL							

COURSE OBJECTIVES:

The objective of this course is:

- Impart knowledge on fundamental aspects of air pollution & control, noise pollution, and solid waste management.
- Provide basic knowledge on sustainable development.
- Introduces some basics of sanitation methods essential for protection of community health.
- Provide basic knowledge on solid waste management.

COURSE OUTCOMES:

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

CO 1: Identify the air pollutant control devices

CO 2: Have knowledge on the NAAQ standards and air emission standards

CO3: Differentiate the treatment techniques used for sewage and industrial wastewater treatment

CO4: Understand the fundamentals of solid waste management, practices adopted in his town/village and its importance in keeping the health of the city.

CO 5: Appreciate the methods of environmental sanitation and the management of community facilities without spread of epidemics.

SYLLABUS:

UNIT – I

Air Pollution: Air pollution Control Methods–Particulate control devices – Methods of Controlling Gaseous Emissions – Air quality standards.

Noise Pollution: Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO14000.

UNIT –II

Industrial Wastewater Management: – Strategies for pollution control - Volume and Strength reduction – Neutralization – Equalization – Proportioning – Common Effluent Treatment Plants - Recirculation of industrial wastes – Effluent standards.

UNIT – III

Solid Waste Management: Solid waste characteristics – basics of on-site handling and collection – separation and processing – Incineration-Composting-Solid waste disposal methods – fundamentals of Land filling.

UNIT – IV

Environmental Sanitation: Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (melas and fares), Schools and Institutions, Rural Sanitation-low cost waste disposal methods.

UNIT- V

Sustainable Development: Definition- elements of sustainable developments -Indicators of sustainable development- Sustainability Strategies- Barriers to Sustainability–Industrialization and sustainable development – Cleaner production in achieving sustainability- sustainable development.

TEXT BOOKS:

1. Environmental Engineering, by Ruth F. Weiner and Robin Matthews – 4th Edition Elesevier, 2003.
2. Environmental Science and Engineering by J.G. Henry and G.W. Heinke – Pearson Education.
3. Environmental Engineering by Mackenzie L Davis & David A Cornwell. McGraw Hill Publishing.

REFERENCE BOOKS:

1. Air Pollution and Control by M.N. Rao & H.N. Rao
2. Solid Waste Management by K. Sasi Kumar, S.A. Gopi Krishna. PHI New Delhi.
3. Environmental Engineering by Gerard Kiley, Tata McGraw Hill.
4. Industrial Water Pollution Control by Nemerow Jr., McGraw Hill Publishing.
5. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard – Cengage Learning.

IV B.TECH IISEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
CODE:R20CC4OE02	**CONSTRUCTION TECHNOLOGY AND MANAGEMENT**						

COURSE OBJECTIVE

- To introduce to the student the concept of project management including network drawing and monitoring.
- To introduce the concept of cost control and resource management.
- To introduce the importance of safety in construction projects.
- To introduce the various equipment related to construction like earth moving equipment, trucks and handling equipment, construction equipment and machinery.

COURSE OUTCOMES:

CO1: Upon the successful completion of this course, the students will be able to:

CO2: Appreciate the importance of construction planning and Project Management.

CO3: Apply the gained knowledge to project Planning and Control.

CO4: Apply the concept of Quality control and Safety Management in construction.

CO5: To find out the function of various construction equipment's.

UNIT- I INTRODUCTION:

Construction projects- Project management- Main causes of project failure, Origin of PERT and CPM, Planning, Scheduling and controlling, Bar charts, Milestone charts, weaknesses in Bar charts, PERT and CPM networks – Comparison, Event, Activity, Rules for drawing networks, Numbering the events (Fulkerson's law), Dummy activities.

UNIT –II PROJECT MANAGEMENT THROUGH NETWORKS:

Time estimate-Expected time, Earliest allowable occurrence time, Latest allowable occurrence time, slack, project duration, probability of completion, Start and Finish time estimates, Floats, Project scheduling, Critical and sub-critical path. Updating – Process of updating.

COST CONTROL: Direct cost- indirect cost- total project cost- Optimization of cost through networks- Steps involved in optimization of cost.

UNIT- III PROJECT PLANNING & ORGANIZATION:

Development of project plan, objective and conception– Programming – Scheduling – Project Organization – Project budget fund flow statement – Controlling system.

CONTRACTS: Introduction – Types of Contract – Contract document – Specifications – Important conditions of contract – Tender and tender document – Deposits by the contractor – Arbitration – M. Book, R.A Bills & Advances – Muster Roll.

UNIT- IV RESOURCE MANAGEMENT:

Introduction- Resource smoothing- Resource levelling- Objectives of material management- Costs- Functions of material management department- ABC classification of materials-Introduction to Green Technologies-NBC code book-2016.

UNIT- V QUALITY CONTROL AND SAFETY MANAGEMENT:

Importance of quality- Elements of quality- Organization for quality control- Quality assurance techniques- Total quality management- ISO – 9000. Accident prevention programme- immediate attention in case of accident- Approaches to improve safety in construction- Safety benefits, Prevention of fires in construction industries- Safety information system.

TEXT BOOKS:

1. Construction Engineering and Management by Dr. S. Seetharaman- Umesh Publications, Nai Sarark, Delhi.

2. Fundamentals of PERT/CPM and Project Management by S. K. Bhattacharjee- Khanna Publishers, Nai Sarak- Delhi.

3. S. Sanga Reddy & Meyyappan, "Construction Management", Kumaran Publications, 2009.

4. Gahlot, P.S & Dhir, D.M., "Construction Planning and Management", Wiley Eastern Limited, 1992.

5. Punmia B.C., "Project Planning and Control with PERT and CPM", Laxmi Publications, New Delhi, 1987.

REFERENCE BOOKS:

1. Construction Management & Planning by B. Sengupta & H. Guha- Tata Mc Graw – Hill Publishing Co. Ltd., New Delhi.

2. Construction Planning, Equipment & Methods by Peurifoy R. L. - Mc Graw – Hill International Book Company.

3. PERT and CPM – Punmia, Laxmi Publications, 3rd edition 1987.

4. PERT & CPM Principles and applications by L. S. Srinath- Affiliated East West Press.

5. Jerome D. Wiest & K. Levy, "Management Guide to PERT/CPM".

6. Clough R.H. & Sears. G.A, "Construction Project Management" 2008.

E-LEARNING: NPTEL-http://nptel.ac.in/courses/105103093/

EEE

LIST OF OPEN ELECTIVES

Open Elective-I

S.No.	Subject Code	Open Elective-I Subject Title	Department Offering the Subject	No.of periods per week			No.of Credits
				L	T	P	C
1	R20CC1OE03	Micro Electro Mechanical System	EEE	3	0	0	3
2	R20CC1OE04	Fundamentals of Electrical Engineering	EEE	3	0	0	3

Open Elective-II

S.No.	Subject Code	Open Elective-I Subject Title	Department Offering the Subject	No.of periods per week			No.of Credits
				L	T	P	C
1	R20CC2OE03	Hybrid Electric Vehicles	EEE	3	0	0	3
2	R20CC2OE04	Energy Audit and Conservation	EEE	3	0	0	3

Open Elective-III

S.No.	Subject Code	Open Elective-I Subject Title	Department Offering the Subject	No.of periods per week			No.of Credits
				L	T	P	C
1	R20CC3OE03	Concept of Smart Grid Technologies	EEE	3	0	0	3
2	R20CC3OE04	Industrial Automation	EEE	3	0	0	3

Open Elective-IV

S.No.	Subject Code	Open Elective-I Subject Title	Department Offering the Subject	No.of periods per week			No.of Credits
				L	T	P	C
1	R20CC4OE03	Non-Conventional Energy Resources	EEE	3	0	0	3
2	R20CC4OE04	Electrical Safety	EEE	3	0	0	3

Open Elective-I III B. TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1OE03	Micro Electro Mechanical System						

Course Objectives:

To impart the basics of Micro Electro Mechanical Systems (MEMS).

To know the principle and various devices of MOEMS

To learn about various sensors and actuators used in MEMS.

To understand the principle and various devices of Micro Fluidic systems.

To acquire the knowledge on concepts of bio and chemical systems and devices.

Course Outcomes:

After completion of this course, Students will be able to

CO1: explain the basics of MEMS sensors and actuators. (K2)

CO2: Know the working principle of MOEMS. (K2)

CO3: Use various Magnetic Sensors and Actuators. (K3)

CO4: Explain the principle of Micro Fluidic systems. (K2)

CO5: Illustrate the Chemical and Bio Medical Micro Systems. (K4)

UNIT-I: Introduction & Thermal Sensors and Actuators

Definition of MEMS, MEMS history and development, micro machining, Principles of sensing and actuation: piezo electric, strain, pressure, flow, MEMS gyroscopes, Thermal energy basics and heat transfer processes, thermo devices, thermal flow sensors, micro hot plate gas sensors, micro spring thermal actuator, data storage cantilever.

UNIT-II: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT-III Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on Hall Effect, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, bidirectional micro actuator, and feedback circuit integrated magnetic actuator.

UNIT-IV: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, electro wetting, electro thermal flow. Radio Frequency MEMS: RF - based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, MEMS switches, phase shifter.

UNIT-V: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose(E-nose), mass sensitive chemo sensors, fluorescence detection, calorimetric.

Text Books:

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

Reference Books:

Foundation of MEMS, Chang Liu, Prentice Hall Ltd.

MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.

MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.

Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Web Resources:

https://nptel.ac.in/courses/117105082

https://nptel.ac.in/courses/108108113

Open Elective-I III B. TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1OE04	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**						

Course Objectives:

To understand operation of various basic electrical components.

To analyse circuits by using basic network theorems and reduction techniques.

To familiarize Magnetic circuits.

To familiarizes about D.C Machines operation,

To identify the importance of transformers and induction motor.

Course Outcomes:

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

CO1: Describe the history and classify elements of electrical engineering(K3)

CO2: Apply various laws to the electrical circuits. (K3)

CO3: Describe the concept of self, Mutual Impedances. (K3)

CO4: Measure the performance quantities such as losses, efficiency of DC machines(k3)

CO5: Create the construct of transformer and Induction motor(k3)

UNIT I Introduction to Electrical Engineering-

History of Electrical Engineering -Network elements classification, Circuit concepts –Resistor(R) - Inductor(L) - Capacitor(C) - Ohm's law - Kirchhoff's laws Voltage and Current Sources (Ideal and Non-Ideal)- Independent and Dependent Sources- Voltage - Current relationship for passive elements.

UNIT II Network Equations and Reduction Techniques–

Source transformation - Network reduction techniques series, parallel, series parallel, star-to-delta or delta-to-star transformation, Nodal analysis, mesh analysis for D.C excitations.

UNIT III Magnetic Circuits:

Concept of self, mutual inductance, coefficient of coupling, dot convention rules and analysis of simple circuits – simple problems.

UNIT-IV DC Machines:

Principle Operation-Constructional features-induced EMF-Types of DC generators-Working of DC motor-Torque expression-3point starter-Speed controls-Losses and Efficiency by direct loading..

UNIT V Transformers:

Constructional details-working principle-EMF equation-losses and efficiency-open/short circuit tests.

Induction Motors: 3-Phase Induction motor Construction-working principle-Types-slip-Performance characteristics-applications

Text Books:

D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1stedition, McGraw Hill Education (India) Private Limited, 2017.

B.L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1stedition, S. Chand Publishing, New Delhi, 2006.

Theory & Problems of Electric Circuits by Joseph A Edminister- schaum series, 6th edition

Reference Books:

S.K.Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.

Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008

Fundamentals of Electric Circuits by Alexander & Sadiku, 2nd edition.

(Open Elective -II) III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code:R20CC2OE03	Hybrid Electric Vehicles						

Course Objectives:

The objectives of this course is to

1. Familiarize working of different configurations of electric vehicles.

2. Explain the properties of batteries and its types.

3. Gain the knowledge in the Engine rating, Requirements of Dc & Ac Electrical Machines.

4. Impart the knowledge about electric vehicle drive systems.

5. Familiarize hybrid electric vehicles.

Course Outcomes:

After completion of this course Students will be able to

CO1: Analyse the behaviour of an electrical vehicles. [K4]

CO2: Measure the performance quantities such as Capacity, and Properties of Batteries. [K3]

CO3: Know the different ratings of DC and AC Electrical Machines. [K3]

CO4: Analyse the importance of components of Electric Vehicle Drive Train. [K4]

CO5: Analyse the different types of HEV. [K4]

UNIT–I: Electric Vehicles

Introduction – Components - Vehicle mechanics – Roadway fundamentals - Vehicle kinetics, - Dynamics of vehicle motion - Propulsion System Design.

UNIT–II: Battery

Basics – Types, Parameters – Capacity - Discharge rate - State of charge - state of Discharge - Depth of Discharge - Technical characteristics - Battery pack Design - Properties of Batteries.

UNIT–III: DC & AC Electrical Machines

Motor and Engine rating – Requirements - DC machines - Three phase A/c machines - Induction machines - Permanent magnet machines - Switched reluctance machines.

UNIT IV:Electric Vehicle Drive Train

Transmission configuration-Components- Gears-Differential-Clutch-Brakes regenerative Braking - Motor sizing.

UNIT–V: Hybrid Electric Vehicles

Types – series - Parallel and series - Parallel configuration – Design – Drive train - Sizing of components. Scenario of HEV in Indian Market

Text Books:

1. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

2. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.

Reference Books:

1. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000.

2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010

Web References:

1. https://www.iare.ac.in/sites/default/files/IARE_HEV_LN_0.pdf

2. http://nptel.ac.in/courses/108103009/.

(Open Elective -II) III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code:R20CC2OE04	Energy Audit and Conservation						

Course Objectives:

To understand energy efficiency, scope, conservation and technologies and design energy efficient lighting systems.

To estimate/calculate power factor of systems and propose suitable compensation techniques.

To understand energy conservation in HVAC systems.

To calculate life cycle costing analysis and return on investment on energy efficient technologies

Course Outcomes:

After completion of this course students will be able to

CO1: illustrate energy efficiency, scope, conservation and technologies. (K2)

CO2: Design energy efficient lighting systems. (K4)

CO3: Estimate/calculate power factor of systems and propose suitable compensation techniques. (K4)

CO4: Calculate life cycle costing analysis and return on investment on energy efficient technologies. (K3)

CO5: Calculate power factor of systems and propose suitable compensation techniques. (K3)

Unit-I: Basic Principles of Energy Audit and management Energy audit

Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management –Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

Unit-II: Lighting

Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

Unit-III:b Power Factor and energy instruments

Power factor – Methods of improvement – Location of capacitors – Power factor with nonlinear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt–hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

Unit–IV: Economic Aspects and Analysis-I

Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts).

Unit-V: Economic Aspects and Analysis-II

Calculation of simple payback method – Net present worth method – Power factor correction – Lighting – Applications of life cycle costing analysis – Return on investment.

Text Books: Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications, 2012.

Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995.

Reference Books:

Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.

Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.

Energy management hand book by W.C.Turner, John wiley and sons.

Energy management and conservation –k v Sharma and pvenkata seshaiah-I KInternational Publishing House pvt.ltd, 2011

Open Elective-III IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	Total Marks	CREDITS
	3	-	-	30	70	100	3
Code:R20CC3OE03	**CONCEPT OF SMART GRID TECHNOLOGIES**						

COURSE OBJECTIVES:

- The objectives of this course is
- To explain the concept of smart grid and developments on smart grid.
- To Impart Knowledge in Smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To inculcate the security in smart substations, feeder automation and application for monitoring and protection.
- To gain the knowledge on micro grids and distributed energy systems.
- To know power quality aspects in smart grid.

COURSE OUTCOMES:

After the completion of the course the student should be able to:

CO1: Analyse the smart grid policies and developments in smart grids. [K4]

CO2: Develop concepts of smart grid technologies in hybrid electrical vehicles etc.[K4]

CO3: Illustrate the different types of smart substations and feeder automation.[K4]

CO4: Analyse micro grids and distributed generation systems.[K4]

CO5: Analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.[K4]

Unit-I: Introduction to Smart Grid

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International

policies on Smart Grid. Case study of Smart Grid.

Unit-II: Smart Grid Technologies: Part 1

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR),Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Unit-III: Smart Grid Technologies: Part 2

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

Unit-IV: Micro grids and Distributed Energy Resources

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of Inter connection, protection & control of microgrid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

Unit-V: Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

TEXT BOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

REFERENCE BOOKS:

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

WEB REFERENCE:

https://www.bharathuniv.ac.in/colleges1/downloads/courseware_eee/Notes/CE3/BEE019%20smart%20grid.pdf

https://ctijabalpur.com/Download/Study-Material/Smart%20Grid%20Notes.pdf

https://onlinecourses.nptel.ac.in/noc21_ee68/preview

Open Elective-III IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	Total Marks	CREDITS
	3	-	-	30	70	100	3
Code:R20CC3OE04	**INDUSTRIAL AUTOMATION**						

COURSE OBJECTIVES:

The objectives of this course is to acquire knowledge on

1. The basic concepts of programmable logic controllers and its applications.

2. Familiarize the students in programming formats and construction of PLC ladder diagrams.

3. The various PLC registers.

4. PLC functions, Data handling functions and controlling of two axes and three axes Robots with PLC.

5. Study the Analog PLC operation and different examples.

Course Outcomes:

After completion of this course, Students will be able to

CO1: Illustrate the basics of PLC & its Programming. [K2]

CO2: Analyze the Characteristics of Registers, module addressing and its importance in Ladder diagram. [K4]

CO3: Develop PLC programs using various functions of PLCs for various Industrial applications of PLC [K4]

CO4: Distinguish between various data handling functions. [K4]

CO5: Differentiate the Analog modules and systems, Analog signal processing, multi bit data processing. [K2, K4]

UNIT-I: Basics of PLC & PLC Programming

PLC system - I/O modules and interfacing – CPU processor - Programming equipment - Programming formats - construction of PLC ladder diagrams -Devices connected to I/O modules - Input instructions – Outputs - Operational procedures - Programming examples using contacts and

coils - Ladder diagrams for process control: Ladder diagrams - ladder diagram construction and flow chart for spray process system.

UNIT-II: PLC Registers

Characteristics of Registers - module addressing -Holding registers - Input registers - Output registers.

UNIT-III: PLC Functions

PLC Functions: Timer functions and Industrial applications – Counters - Counter function industrial applications - Arithmetic functions - Number comparison functions -Number conversion functions.

UNIT-IV: Data Handling Functions

Data handling functions: SKIP - Master control Relay - Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register - Sequence functions and applications - Controlling of two axes and three axis Robots with PLC - Matrix function.

UNIT-V: Analogue PLC Operation

Analog modules and systems - Analog signal processing, multi bit data processing - Analog output application examples - PID principles - Position indicator with PID control - PID modules - PID tuning - PID functions.

TEXT BOOKS:

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

REFERENCE BOOKS:

1. Programmable Logic Controllers Hardware and Programming by Max Rabiee Goodheart-Wilcox.

2. Programmable Logic Controllers by Frank D. Petuzeela McGraw-Hill.

3. Industrial Automation and Process control by Jon Stenerson Prentice-Hall.

WEB REFERENCE:

1. http://users.isr.ist.utl.pt/~jag/courses/api13/docs/API_I_C2.pdf

2. https://nptel.ac.in/courses/108105063

3. https://nptel.ac.in/courses/108105088

Open Elective-IV IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	Total Marks	CREDITS
	3	-	-	30	70	100	3
Code:R20CC4OE03	Non-Conventional Energy Resources						

COURSE OBJECTIVES:

Understand the fundamentals of solar energy conversion and familiarize with solar geometry

Learn basic principles and operational features of wind energy and Bio mass energy

To educate Geothermal ,Ocean, tidal and wave energy principles and its operation

To study basic principle and working of Thermal Electric Power.

Analyze the principle and operation of direct energy conversion.

COURSE OUTCOMES:

After completion of this course, Students will be able to

CO1: Illustrate the principles of solar radiation and their applications. (K3)

CO2: Analyze the functioning of basic components of wind energy and the utilization of biomass in power generation. (K2)

CO3: Summarize the working principles of geothermal, ocean, tidal and wave energy techniques. (K3)

CO4: Interpret the functioning of Thermal Electric Power. (K3)

CO5: Analyze the MHD power generation and its future prospects.(K3)

UNIT – I: Introduction & Solar Energy

Introduction to Energy Sources and their availability- renewable sources-The solar constant- Solar Radiation at the Earth's surface-instruments for measuring solar radiation - solar radiation on titled surfaces-solar ponds-Applications of Solar ponds- solar heating-Photovoltaic energy conversion.

UNIT – II: Wind Energy and Bio-Mass

Principles of wind energy conversion, Components of WECS- horizontal and vertical axis windmills- performance characteristics. Bio fuels- Methods for obtaining energy from Biomass- Thermal gasification of Biomass.

UNIT – III: Geothermal Energy, Ocean Energy, Tidal and Wave Energy

Introduction of Geothermal Energy- Nature of Geothermal fields- Geothermal Sources- OTEC- Methods of ocean thermal electric power generation- Open cycle and closed cycle- Principle of Tidal power- Components of Tidal power plants- Advantages and Disadvantages of Wave energy- Energy and power from the Waves.

UNIT – IV: Thermal Electric Power

Introduction- Thermo electric power generation- See-beck, Peltier, Thomson effects - Thermo electric power generation- Thermo electric materials- Selection of materials.

UNIT – V: MHD Power Generation

Introduction- Principle of MHD power generation- MHD Systems- Open cycle and closed cycle Systems- Advantages of MHD Systems- International Status of MHD power generation and its future prospects.

TEXT BOOKS:

G.D. Rai, “Non-Conventional Energy Sources”, Dhanpat Rai and Sons

Tiwari and Ghosal, “Renewable energy resources”, Narosa publications

REFERENCE BOOKS:

Twidell& Weir, “Renewable Energy Sources “

Sukhatme, “Solar Energy”, Tata McGraw-Hill Education.

B.S Magal Frank Kreith& J.F Kreith, “Solar Power Engineering “

Frank Krieth& John F Kreider, “Principles of Solar Energy”

Open Elective-IV IV B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	Total Marks	CREDITS
	3	-	-	30	70	100	3
Code:R20CC4OE04	Electrical Safety						

COURSE OBJECTIVES:

To provide a comprehensive exposure to electrical hazards, various grounding techniques and safety.

To know various safety Procedures and safety Equipment.

To know about Safety programme structure.

To analyse various electrical maintenance techniques.

COURSE OUTCOMES:

After completion of this course student will be able to

CO 1: Describe electrical hazards and safety equipment. [K3]

CO 2: Analyse and apply various grounding and bonding techniques. [K4]

CO 3: Select appropriate safety method for low, medium and high voltage equipment. [K3]

CO 4: Develop different types of safety programme structures. [K3]

CO 5: Analyse the maintenance of electrical equipment by using various safety & health Standards. [K4]

UNIT-I: Hazards of Electricity and Safety Equipment

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.

UNIT-II: Grounding and Bonding of Electrical Systems and Equipment

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

UNIT-III: Safety Procedures and Methods

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit.

UNIT-IV: Safety Management and Organizational Structure

Electrical safety programme structure, development- company safety team- safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

UNIT-V: Electrical Maintenance and its Relationship to Safety

Safety related case for electrical maintenance- reliability centered maintenance (RCM) - eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

TEXT BOOKS:

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, 'Electrical Safety Handbook',McGraw-Hill Education, 4thEdition, 2012.

REFERENCE BOOKS:

1. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', TheInstitution of Electric Engineers, IET 1994.

2. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.

WEB REFERENCES:

https://www.labtrain.noaa.gov/osha600/refer/menu12a.pdf.

https://nptel.ac.in/courses/108107167.

https://onlinecourses.swayam2.ac.in/nou20_cs08/preview.

ME

R20 OPEN ELECTIVES

OPEN ELECTIVE -1:

1. Rapid Prototyping & 3D Printing (Other than ME)
2. Operations Research

OPEN ELECTIVE -2:

1. Industrial Engineering & Management (Other than ME)
2. Industrial Robotics (Other than ME)

OPEN ELECTIVE -3:

1. Automotive Vehicles
2. Nano Technology

OPEN ELECTIVE -4:

1. Pneumatics & Hydraulic Automation
2. Mechatronics

III B.TECH I-SEMESTER Open Elective -I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1OE06	**RAPID PROTOTYPING AND 3D PRINTING (Other than ME)**						

COURSE OBJECTIVES:

- The course aims at the importance of Rapid Prototyping, classifications, models, specifications of various Rapid Prototype Techniques.
- To learn the different tools, soft-wares required and the applications of Rapid Prototyping.
- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies

COURSE OUTCOMES:

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

CO 1: **Identify** the use of Rapid Prototyping Techniques in the manufacturing of complex Components.

CO 2: **Classify** the Stereo lithography Apparatus and its process.

CO 3: **Illustrate** the process of laminated object manufacturing and fused Deposition Modelling.

CO 4: **Explain** the Selective laser sintering process.

CO 5: **Compare** different method and discuss the effects of the Additive Manufacturing Technologies.

UNIT – I: INTRODUCTION:

Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

UNIT–II: LIQUID-BASED RAPID PROTOTYPING SYSTEMS:

Stereo lithography Apparatus (SLA): models and specifications, process, working principle, layering technology, applications, advantages and disadvantages.

UNIT–III: SOLID-BASED RAPID PROTOTYPING SYSTEMS:

Laminated object manufacturing (LOM) – models and specifications, process, working principle, applications, advantages and disadvantages, Fused deposition modeling (FDM) – models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT – IV: POWDER BASED RAPID PROTOTYPING SYSTEMS:

Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT-V: 3D PRINTING:

Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications. Three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages.

TEXT BOOKS:

1. Rapid prototyping: Principles and Applications – Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press

REFERENCE BOOKS

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.

WEB REFERENCES:

1. URL:https://mosafavi.iut.ac.ir/sites/mosafavi.iut.ac.ir/files//.../rapid_prototyping_1_0.pdf.
2. https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf

III B.TECH I-SEMESTER Open Elective -I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1OE07	**OPERATIONS RESEARCH**						

COURSE OBJECTIVES:

The course content enables students to:

- To learn the importance of Operations Research in the design, planning, scheduling, manufacturing and business applications
- To use the various techniques of Operations Research in solving such problems.

COURSE OUTCOMES:

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

CO 1: Illustrate and solve linear programming problems.

CO 2: Solve transportation and assignment problems.

CO 3: Select a suitable sequencing and Solve waiting line theory problems.

CO 4: Solve networking models and replacement problems.

CO 5: Analyze game theory & Dynamic Programming.

UNIT-I INTRODUCTION:

Development-definition, characteristics and phases, types of operation research models, applications.

LINEAR PROGRAMMING PROBLEM: LPP Formulation, graphical method, simplex method, two–phase method, big-M method, duality principle.

UNIT-II TRANSPORTATION PROBLEM:

Formulation, types of initial basic feasible solution using different methods, optimal solution, unbalanced transportation problem, degeneracy.

ASSIGNMENT PROBLEM: Formulation, optimal solution, unbalanced assignment problem, travelling salesman problem.

UNIT-III SEQUENCING:

Introduction, flow, shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing, and two jobs through 'm' machines.

WAITING LINES: Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

UNIT–IV REPLACEMENT:

Replacement Model, Replacement of items that deteriorate, Gradually, Fail suddenly, group Replacement policy analysis, Problems.

NETWORKING MODELS: Earliest Completion time of a project and Critical path, Programme Evaluation Review Technique, Total Slack, Free Slack, Probability of achieving completion date, Cost Analysis, Resource Scheduling-Advantages, Limitations, Distinction between PERT and CPM.

UNIT-V THEORY OF GAMES:

Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 &2 x n games -graphical method.

DYNAMIC PROGRAMMING: Introduction, Bellman's principle of optimality, applications of dynamic programming.

SIMULATION: Definition, types of simulation models, phases of simulation, applications of simulation, inventory and queuing problems, advantages and disadvantages.

TEXT BOOKS:

1. Operations Research, S.D.Sharma, KedarNath Ram Nath Publishers
2. Operations Research, A.M.Natarajan, P.Balasubramani and A. Tamilarasi, Pearson Education.

REFERENCE BOOKS:

1. Introduction to O.R, Hiller &Libermann, Tata McGraw Hill
2. Operations Research, R.Pannerselvam, PHI Publications
3. Operations Research, Wagner, PHI Publications

WEB LINKS:

- http://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf
- https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf

III B.TECH II-SEMESTER Open Elective -II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC2OE05	**INDUSTRIAL ENGINEERING & MANAGEMENT (Other than ME)**						

COURSE OBJECTIVES

The course content enables students to:

- Understand various aspects related with industrial engineering and its relevance in the industrial environment.
- Inculcate the organizational structure, plant location and plant layout, production planning and control, scheduling, forecasting, statistical quality control.
- Equip the student with the basic management concepts and functions and to provide knowledge relating to recruitment, selection, training, and motivation of employees in the organization

COURSE OUTCOMES

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

CO1 Differentiate industrial engineering and industrial engineer, Taylor's and Fayol's principles

CO2 Design a system of organizational structures to achieve desired needs.

CO3 Understand the techniques, skills on how to provide wages and incentives for the labourers

CO4 Evaluate the concept of resource management and job evaluation techniques and benefits.CO5 Apply concepts of operations management for design of industry layout

UNIT – I: INTRODUCTION:

Definition of industrial engineering (I.E), development, role of an industrial engineer, differences between production management and industrial engineering, concepts of management, importance, functions of management, Taylor's principles, theory X and theory Y, Fayol's principles of management, bath tub curve.

UNIT II: ORGANIZATIONAL STRUCTURES:

Departmentalization and Decentralization, Types of Organization structures - Line organization, Line and staff organization, Functional organization, Committee organization, Matrix

organization, Virtual Organization, Cellular Organization, Team structure, Boundary less organization, Inverted pyramid structure, Lean and flat organization structure and their merits, demerits and suitability, Industrial relations.

UNIT – III: WAGE & INCENTIVE SYSTEMS:

Wages – definition, types – wage differentials – reasons, methods of wage payments, types of incentives, standard wage plans – Halsey, Weir, Emerson's, Rowans Gantt's task and Bonus systems, - Taylor's piece rate systems, Merric's piece rate system – Numerical problems on the above plans, incentives to the supervisor and executives, Labor Act.

UNIT – IV: RESOURCE MANAGEMENT:

Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, advantaged and disadvantages of merit rating.

UNIT – V: OPERATIONS MANAGEMENT:

Product design process- Process selection-Types of production system(Job, batch and Mass Production),Plant location-factors, Urban & Rural sites comparison, Types of Plant Layouts-Design of product layout, Line balancing (RPW method), Value analysis-Definition-types of values- Objectives, Phases of value analysis.

TEXT BOOKS:

1. Industrial Engineering and management by O.P Khanna, Khanna Publishers.
2. Industrial Engineering and Production Management, Martand Telsang, S.Chand& Company Ltd. New Delhi.
3. Statistical Quality Control by Gupta.

REFERENCE BOOKS:

1. Industrial Management by Bhattacharya DK, Vikas publishers.
2. Operations Management by J.G Monks, McGrawHill Publishers.
3. Industrial Engineering by Banga& Sharma.
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. Industrial Engineering and Management by Raju, Cengage Publishers.

WEB LINKS:

- https://nptel.ac.in/courses/112/107/112107292/
- https://nptel.ac.in/courses/112/107/112107142/
- https://core.ac.uk/download/pdf/55638606.pdf
- https://civildatas.com/download/industrial-engineering-and-management-by-khanna

III B.TECH II SEMESTER Open Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC2OE06	**INDUSTRIAL ROBOTICS (Other than ME)**						

COURSE OBJECTIVES

The course content enables students to:

- Introduce the concepts of Robotic system, its components and control related to robotics.
- Learn about analyzing robot kinematics.

COURSE OUTCOMES

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

CO1: Identify Robot terminology and importance

CO2: Select appropriate type of actuators for different applications

CO3: Choose appropriate sensors for different applications

CO4: Analyse the kinematics of robot related to transformations

CO5: Illustrate present and future applications for robots

UNIT 1: FUNDAMENTALS OF ROBOTICS:

Robot and industrial robots, advantages, components of robot, Robot history, robotic controls and systems, classification, challenges and opportunities, the scenarios of industrial robotics and advanced robotics

UNIT 2: ACTUATORS:

Types, working principles, applications and advancements (hydraulic devices, Electric motors such as DC servomotors and stepper motors, Pneumatic devices, as well as other novel actuators)

UNIT 3: SENSORS:

Basic Elements, General Classification of Sensors, types and working, use of sensors in robotics.

UNIT 4: ROBOT KINEMATICS

The fundamentals of kinematics, differential kinematics and statics: Kinematic chains, Forward kinematics, The Jacobian and its properties**,** Inverse kinematics: analytical methods

UNIT 5: ROBOT APPLICATION IN MANUFACTURING:

Material Transfer, Material handling, loading and unloading, Processing, spot and continuous arc welding & spray painting, Assembly and Inspection. Future applications of robots. Path planning in robotics.

TEXT BOOKS:

1.Industrial Robotics, Groover M P, Pearson Education.

2.Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, Oxford Publications.

REFERENCES:

1.Robotics and Control, Mittal R K & Nagrath I J, Tata McGraw Hill.

2. Robotic Engineering, Richard D. Klafter, Prentice Hall.

WEB REFERENCES:

1. http://planning.cs.uiuc.edu/node659.html
2. https://www.edx.org/course/robot-mechanics-and-control-part-i
3. https://www.edx.org/course/robotics-foundation-ii-robot-control
4. https://nptel.ac.in/courses/112/105/112105249/
5. http://www.robotictutorials.com/ → for tutorials
6. ARC lab material – in house Dept. of Mechanical Engineering, NEC

IV B.TECH I SEMESTER Open Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC3OE05	**AUTOMOTIVE VEHICLES**						

COURSE OBJECTIVES

The course content enables students to:

- Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry.
- Understand Safety standards, advances in towards autonomous vehicles.

COURSE OUTCOMES

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

CO1 **Illustrate** different types of chassis and body parts.

CO2 **Examine** the transmission systems and accessories used in automobiles.

CO3 **Elaborate** steering mechanisms.

CO4 **Analyze** different braking and suspension mechanisms.

CO5 **Apply** the knowledge of electrical systems in the automotive vehicles.

UNIT-I CHASSIS & BODY:

Classification of vehicle, layout with reference to power plant, steering location and drive, chassis, construction and details (frames, sub-frames, defects in frame, frameless vehicles, vehicle dimensions), details of chassis & body materials, Integrated body construction, Vehicle interior system (dash board & seating system), head roofs.

UNIT-II TRANSMISSION & DRIVELINE:

Clutches, principle, types, Fluid coupling and torque convertors, problems on performance of automobile such as resistance to motion, tractive efforts, engine speed, power and acceleration requirements. Determination of gear box ratios for different vehicle applications, different types of gear boxes, Automatic transmission, Effect of driving thrust and torque-reaction, Hotchkiss drives, Torque tube drive, radius rods, Propeller shaft, Universal joints,

UNIT-III FRONT AXLE & STEERING:

Front axle types, rigid axle and split axle, constructional details, materials, front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out, Wheel alignment and balancing, Condition for

true rolling motion off-road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box.

UNIT-IV BRAKING & SUSPENSION:

Type of brakes, Principles of shoe brakes, Constructional details – materials. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Parking & Exhaust brakes, power & power assisted brakes, Antilock Breaking System (ABS), Testing of brakes. Types of suspension, factors influencing ride comfort, types of suspension springs (leaf & coil springs).

UNIT-V ELECTRICAL SYSTEM:

Battery, Charging circuit, Alternator, generator, current – voltage regulator – starting systems, mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature, indicator, wiring harness, Trouble shooting.

TEXT BOOKS:

1. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002.
2. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.

REFERENCE:

1. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi, 2005.
2. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.
3. K.K. Ramalingam, "Automobile Engineering ", Scitech Publications (India) PVT.
4. Automotive Mechanics By William H. Crouse, Donald L. Anglin · 1984.

WEB LINKS:

1. https://web.iitd.ac.in/~achawla/course_pdfs/4.%20MEL736/1-Automobile_introduction.pdf
2. https://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf
3. http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Automotive%20Engineering%20Powertrain,%20Chassis%20System%20and%20Vehicle%20Body.pdf

IV B.TECH I SEMESTER Open Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC3OE06	**NANO TECHNOLOGY**						

COURSE OBJECTIVES

The course content enables students to:

- Attain foundational knowledge of the Nanoscience and related fields.
- Acquire an understanding the Nanoscience and Applications.

COURSE OUTCOMES

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

CO1: Enumerate basics of nano materials and technology.

CO2: Illustrate the synthesis of nano materials.

CO3: Develop an idea for preparation of nano size materials.

CO4: Summarize the knowledge on tools used in nano technology.

CO5: Compare different nano fabrication methods.

UNIT – I: **INTRODUCTION:**

Evolution of science and technology, Introduction to Nanotechnology, Nanotechnology - Definition, Significance, Difference between Nanoscience and Nanotechnology, Feynman predictions on Nanotechnology, Moore's law, Bottom up and top down approaches, challenges in Nanotechnology.

UNIT – II:NANO MATERIALS, SYNTHESIS:

History of materials, Nanomaterial Definition, Classification of Nanostructured materials, causes of interest in nanomaterial, some present and future applications of nanomaterial, Carbon nanotubes, Nano composites, nano fluids-An overview of preparation, properties, applications.

UNIT – III:**PROCESSING OF NANO MATERIALS**:

Processes for producing ultrafine powders mechanical grinding, wet chemical synthesis of nanomaterial. Gas phase synthesis of Nanomaterial, gas condensation processes, chemical vapour condensation, laser ablation

UNIT – IV:CHARACTERIZATION AND TOOLS:

Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunnelling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy- X ray methods –Fluorescence

UNIT – V:NANOFABRICATION:

Introduction - micro, nanofabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, MEMS, NEMS -An introduction. Nanotechnology applications in Mechanical Engineering: Nano mechanics, Nano scale heat transfer, nano-machining, molecular dynamic simulation

TEXT BOOKS:

1. Nano science and nanotechnology by M.S. Ramachandra Rao, Shubrasingh, Wiley publishers
2. Nano structures & Nano materials by Guozhongcao, Imperial college press.2nd Edition.

REFERENCE BOOKS

1. Micro manufacturing and Nano Technology by N.P.Mahalik,.Springer,2006
2. Nano Technology by Mark Ratner &Danier Ratner, Prentice Hall
3. Nano materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristol and Philadelphia.

WEB LINKS:

1. https://core.ac.uk/download/pdf/55611506.pdf
2. https://ec.europa.eu/programmes/erasmus-plus/project-result-content/fe710461-5da6-42bd-9351-828558ab56da/Nanotechnology%201%20Fundamentals%20of%20Nanotechnology.pdf
3. https://www.kth.se/social/upload/54062f97f2765416cecdfd74/HT14-IM2655_Lecture%201.pdf

IV B.TECH I SEMESTER Open Elective-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC4OE05	**PNEUMATICS & HYDRAULIC AUTOMATION**						

COURSE OBJECTIVES

The course content enables students to:

- Equip the student with fundamental knowledge of fluid power systems, pneumatic systems and hydraulic systems.
- Develop knowledge of the performance of hydraulic circuits using various hydraulic elements. Pneumatic circuits using various Pneumatic elements

COURSE OUTCOMES

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

CO 1 **Compare** the Pneumatic and Hydraulic systems working principles and components.

CO 2 **Explain** the performance of hydraulic actuators using cylinders.

CO 3 **Explain** the fluid control valves working and construction.

CO 4 **Analyze** the performance of hydraulic circuits using various hydraulic elements.

CO 5 **Analyze** the performance of Pneumatic circuits using various Pneumatic elements

UNIT – I: INTRODUCTION TO PNEUMATIC AND HYDRAULICS:

Fluid Power and Its Scope, Applications of fluid power. Advantages and disadvantages of fluid power Classification of Fluid Power Systems, Basic Components of a Hydraulic System, Basic Components of a Pneumatic System, Comparison between Hydraulic and Pneumatic Systems, Comparison of different power systems.

UNIT – II: HYDRAULIC & PNEUMATIC ACTUATORS:

Classification of hydraulic & pneumatic actuators, hydraulic & pneumatic cylinders - construction and working of single acting and double-acting cylinders, Graphical symbols of different linear actuators, Cylinder Force, Velocity and Power, Various Methods of Applying Linear Motion Using Hydraulic Cylinders- vertical cylinder, Horizontal cylinder, Inclined cylinder. First, Second and Third Class Lever Systems.

UNIT – III: FLUID POWER CONTROL VALVES:

Different types of valves used in fluid power, Directional control valves (DCV) - classifications - working and construction of various direction control valves -applications, Pressure-control valves (PCV) – classifications - working construction of various pressure control valves – applications. Flow

control valves (FCV) - classifications - working construction of various flow control valves - applications. time delay, quick exhaust, twin pressure, shuttle.

UNIT – IV: HYDRAULIC CIRCUITS:

Various hydraulic circuits, Nomenclature, Graphical Symbols, Control of a Single-Acting Hydraulic Cylinder and a Double-Acting Hydraulic Cylinder, Double-pump circuit, sequencing circuit, Circuit for Fast Approach and Slow Die Closing, Performance of hydraulic circuits using various hydraulic elements

UNIT – V: PNEUMATIC CIRCUITS:

Basic pneumatic circuits, Nomenclature, Graphical Symbols, Development of single Actuator Circuits, Development of multiple Actuator Circuits, Cascade method for sequencing, introduction to piping and its software's.

TEXT BOOKS:

1. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw Hill.

2. Hydraulics, Fluid Mechanics and Hydraulic Machinery by P.N. Modi, S.M. Seth, Standard Book House.

3. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S. Chand *Publishing*

4. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.

REFERENCES:

1. Hydraulic and Pneumatic Controls: Understanding made Easy by K.Shanmuga Sundaram, S.Chand, New Delhi, 2006

2. Fluid Mechanics and Fluid Power Engineering by D.S.Kumar, SK Kataria and Sons.

3. Fluid Power with Applications by Anthony Esposito, Pearson.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://nptel.ac.in/courses/112/105/112105046/
3. http://www.just.edu.jo/~haalshraideh/Courses/IE431/Lecture_slides/Hydrolics%20and%20Pneumatics.pdf

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Open Elective-IV	3	0	0	30	70	100	3
Code: R20CC4OE06	**MECHATRONICS**						

COURSE OBJECTIVES: The course content enables students to:

- Understand key elements of Mechatronics system, representation into block diagram
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application

COURSE OUTCOMES:

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

CO1: Discuss the elements of a microcontroller as well as the operating principles of motors, sensors, and circuits commonly used in mechatronic devices

CO2: Describe the basics of Semiconductors used in mechatronics.

CO3: Analyze the Sensors and Transducers for different applications.

CO4: Analyze different logics ad logical controls

CO5: Apply the concepts of mechatronics for various applications

UNIT 1: INTRODUCTION TO MECHATRONICS

Introduction: Multi-disciplinary Scenario, Origins, Evolution of Mechatronics, An overview of Mechatronics.

SYSTEM MODELLING: Introduction, system modelling, mechanical system, translational mechanical system with spring, damper and mass, Rotational mechanical system with spring, damper and mass; electrical system, modelling electric motor, fluid system, thermal systems, modeling pneumatic actuator

UNIT 2: SEMICONDUCTORS AND ELECTRONICS

Semiconductors, PN junction diode-types, BJT, DIAC, TRIAC, LEDs, transistors,

FET, MOSFET, SCR, IC, DC

UNIT 3: SENSORS AND TRANSDUCERS:

Introduction and background, difference between transducer and sensor, transducers types, transduction principle, photoelectric transducers, thermistors, thermo devices, thermo couple,

inductive transducers, capacitive transducers, pyroelectric transducers, piezoelectric transducers, Hall-effect transducers, Fibre optic transducers.

UNIT 4: DIGITAL LOGIC & PLC:

Digital logic, number systems, logic gates, Boolean algebra, karnaugh maps, application of logic gates, sequential logic, Programmable logic controller (PLC), Digital controllers.

UNIT 5: APPLICATIONS IN MECHATRONICS

Sensors for condition monitoring, mechatronic control in automated manufacturing, artificial intelligence in mechatronics, Fuzzy logic applications in mechatronics, micro sensors in mechatronics, and contemporary issues.

TEXT BOOKS:

1. Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering (2010), W. Bolton, Pearson Education.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, PWS publishing company.

REFERENCES:

1. Mechatronics: Principles, concepts and applications by Nitaigour Premchand Mahalik, Tata – McGraw Hill Publishing Company Ltd.
2. Mechatronics: Integrated Mechanical Electronic Systems by K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Willey Publication, 2008

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/103/112103174/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall-2014/
3. https://nptel.ac.in/downloads/112101098/

ECE

R20 OPEN ELECTIVES

Open Elective – I:

1. Principles of Signals, Systems & Communications (Other than ECE)
2. Introduction to Data Science

Open Elective – II:

1. Fundamentals of Image Processing (Other than ECE)
2. Global Positioning System (GPS)

Open Elective – III:

1. Introduction to Microprocessors and Microcontrollers (Other than ECE)
2. Nano Electronics

Open Elective - IV:

1. Introduction to Embedded Systems (Other than ECE)
2. Embedded and Real time Operating Systems

III B.TECH I SEMESTER (OPEN ELECTIVE-I)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20EC3104	PRINCIPLES OF SIGNALS, SYSTEMS AND COMMUNICATIONS (Other than ECE)						

COURSE OBJECTIVES:

1. To build elementary signals and implement Trigonometric and Exponential Fourier series.
2. To Construct Fourier transform, Hilbert Transform and Laplace transform of continuous time signals and properties of Fourier Transform.
3. To develop various properties of Laplace and z- transforms of continuous time signals.
4. To Identify linear time variant and linear time invariant systems.
5. To construct of various filters and about sampling.

COURSE OUTCOMES:

After completion of this course, the student should able to

CO1: Explain basic concepts of signals **[K2].**

CO2: Analyze time-domain signals in frequency-domain using Fourier transforms **[K4].**

CO3: Demonstrate the concepts of linear systems **[K2].**

CO4: Illustrate various analog modulation techniques **[K2]**

CO5: Compare various digital modulation techniques **[K4].**

SYLLABUS:

UNIT-I: INTRODUCTION TO SIGNALS

Standard Signals, Signal Operations: Time Shifting, Scaling and Reversal, Classification of Signals: Analog, Digital, Discrete, Periodic and Aperiodic, Even and Odd, Energy and Power.

UNIT-II: SIGNAL ANALYSIS

Introduction to Fourier Series - Trigonometric and Exponential Fourier Series, Fourier Transform - Analysis of non-periodic functions, Fourier Transform of standard signals, Properties of Fourier Transform.

UNIT-III: LINEAR SYSTEMS

Introduction, Definition of system function, Classification of systems. Distortionless transmission, Signal bandwidth and System band width

UNIT-IV: INTRODUCTION TO COMMUNICATION SYSTEMS

Need for Modulation, Types of Modulation, Amplitude modulation- Generation of AM, Demodulation of AM, Frequency modulation, Phase modulation.

UNIT-V: PULSE MODULATION

Pulse Analog Modulation: PAM Modulation and Demodulation, PWM and PPM- modulation and demodulation, Time Division Multiplexing, Frequency Division Multiplexing.

Pulse Digital Modulation: PCM System, Differential pulse code modulation, Delta Modulation, Adaptive delta modulation and comparisons.

TEXT BOOKS:

1. R. P. Singh, S. D. Sapre, "Communication Systems - Analog and Digital, Tata McGraw Hill, Reprint 2003.
2. H. Taub and D. Schilling, "Principles of Communication Systems", TMH, 2003.
3. B.P.Lathi, "Signals systems and communication", BS Publications, 2008.

REFERENCE BOOKS:

1. Simon Haykin, John Wiley, "Communication Systems", 3rd Edition, 2008.
2. P. Ramesh Babu, R. Anandanatarajan, "Signals and Systems", Scitech Publications, 4th Edition, 2006

III B.TECH I SEMESTER (OPEN ELECTIVE-I)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: 20EC3105	INTRODUCTION TO DATA SCIENCE						

COURSE OBJECTIVES:

1. To summarize the basics of Data Science.
2. To outline data collection and data pre-processing methods.
3. To outline the statistical parameters used in Data Science.
4. To illustrate model development and decision making.
5. To illustrate model evaluation by using metrics and prediction.

COURSE OUTCOMES:

After completion of the course, students will be able to

CO1: Summarize the basics of Data Science. **(K2)**

CO2: Outline data collection and data pre-processing methods. **(K2)**

CO3: Outline the statistical parameters used in Data Science **(K2)**

CO4: Illustrate model development and decision making. **(K2)**

CO5: Illustrate model evaluation by using metrics and prediction. **(K2)**

SYLLABUS

UNIT-I: INTRODUCTION

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

UNIT-II: DATA COLLECTION AND DATA PRE-PROCESSING

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

UNIT-III: EXPLORATORY DATA ANALYTICS

Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.

UNIT-IV: MODEL DEVELOPMENT

Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.

UNIT-V: MODEL EVALUATION

Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search.

TEXT BOOKS:

1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.

REFERENCES:

1. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
2. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.

III B.TECH II SEMESTER (OPEN ELECTIVE-II)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	1	0	30	70	100	3
Code: R20CC2OE07	FUNDAMENTALS OF IMAGE PROCESSING (Other than ECE)						

COURSE OBJECTIVES:

- To introduce the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images
- To comprehend the relation between human visual system and machine perception and processing of digital images
- 3. To introduce the concepts of image processing and basic analytical methods to be used in image processing
- To familiarize students with image enhancement and restoration techniques
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression

COURSE OUTCOMES:

After completion of the course, students will be able to

CO1: Interpret the limitations of the computational methods on digital images **(K2)**

CO2: Develop Fourier transform for image processing in frequency domain **(K3)**

CO3: Illustrate the spatial and frequency domain image transforms on enhancement and restoration of images **(K4)**

CO4: Utilize the image enhancement techniques **(K3)**

CO5: Define the need for compression and evaluate the basic compression algorithms **(K1)**

SYLLABUS:

UNIT–I: DIGITAL IMAGE FUNDAMENTALS & IMAGE TRANSFORMS:

Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels. Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

UNIT–II: IMAGE ENHANCEMENT:

Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Spatial Filters: Median Filter, Low Pass and High Pass Filtering.
Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

UNIT–III: IMAGE RESTORATION:

Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT–IV: IMAGE SEGMENTATION:

Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

UNIT–V: IMAGE COMPRESSION:

Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression.

TEXT BOOKS:

1. Digital Image Processing – Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- Mc Graw Hill Education, 2010.
3. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.

REFERENCE BOOKS:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011
2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, Mc Graw Hill Education, 2010.
3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008.
4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2008, 2nd Edition.

WEB LINKS:

1. https://www.youtube.com/watch?v=DSGHkvQBMbs&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8
2. https://www.tutorialspoint.com/dip/index.htm

III B.TECH II SEMESTER (OPEN ELECTIVE-II)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC2OE08	GLOBAL POSITIONING SYSTEM						

COURSE OBJECTIVES:

- To understand the fundamental concepts of GPS.
- To analyze the GPS observables.
- To Demonstrate the Surveying Procedure.
- To list the different methods of processing GPS data.
- To conclude various application areas of GPS.

COURSE OUTCOMES:

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

CO1: Identify the importance of Space segment, Control segment and User segment in GPS **(K3)**

CO2: Analyse the GPS observables like code, phase pseudo ranges, Doppler data and Biases **(K4)**

CO3: Estimate surveying with GPS **(K5)**

CO4: Categorize the different application areas of GPS **(K4)**

CO5: Recommend the Hardware and Software improvements for future GPS **(K5)**

SYLLABUS:

UNIT–I: OVERVIEW OF GPS

Basic concepts- History of GPS, Basic definitions, GPS system operation, Trilateration method. Space segment- constellation, satellites, operational capabilities, denial of accuracy and access. Control segment- master control station, monitor stations, ground control stations. User segment- user categories, receiver types, information services.

UNIT–II: GPS OBSERVABLES

Data acquisition- code pseudo ranges, phase psecudo ranges, Doppler data, biases and noise. Data combinations- linear phase combinations, code, psecud orange smoothing. Atmospheric effects- phase and group velocity, ionospheric refraction, tropospheric refraction, atmospheric monitoring. Reletivitistic effects- special relativity, general relativity, relevant relativistic effects of GPS. Antenna Phase centre offset and variation Multipath- general remarks, mathematical model, multipath reduction.

UNIT–III: SURVEYING WITH GPS

Introduction-terminology definitions-code range vs. carrier phase, real time processing vs. post processing, point positioning vs. relative positioning, static vs. kinematic, static point processing vs. kinematic point processing, and static relative positioning vs. kinematic relative positioning. Observation techniques- point positioning, differential GPS, relative positioning. Field equipment Planning a GPS survey- General remarks, Pre survey planning, field reconnaissance, monumentation, organizational design. Surveying Procedure-pre observation, observation, post observation, ties to control monuments. In Situ data Processing- data transfer, data processing, trouble shooting and quality control, datum transformations, computation of plane coordinates, Survey report.

UNIT–IV: APPLICATIONS OF GPS

General Uses of GPS- global uses, regional uses, local uses. Attitude determination- theoretical and practical considerations. Air borne GPS for photo control. Interoperability of GPS- GPS and inertial navigation systems, GPS and GLONASS, GPS and other sensors.

UNIT–V: FUTURE OF GPS

New application aspects. GPS modernization- future GPS satellites, augmented signal structure. GPS augmentation- ground based and satellite based augmentation. GNSS - GNSS development, GNSS/Loran-C integration. Hardware and software improvements- Hardware, Software.

TEXT BOOKS:

1. B. Hofmann- Wellnhoff , H. Lichtenegger and J. Collins, “GPS theory and practice” , Fifth Edition, Springer-Verlag Wien, Newyork, 2001.
2. Bradford W. Parkinson, James Spilker, “Global Positioning System: Theory and Applications”, Vol. I, 1996.

REFERENCE BOOKS:

1. Gunter Seeber, “Satellite Geodesy Foundations, Methods and Applications”, Walter de Gruyter Publications, 2003.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=sOP6VibhtgU
2. https://www.youtube.com/watch?v=I1KCZCyNWbA
3. https://www.youtube.com/watch?v=Wg3GRhuWBR4
4. https://www.youtube.com/watch?v=usmv_DxnpJE

IV B.TECH I SEMESTER (OPEN ELECTIVE-III)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC3OE07	INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLERS (Other than ECE)						

COURSE OBJECTIVES

1. To familiarize the students with architecture of 8086 microprocessor and 8051 microcontroller.
2. To introduce the assembly language programming concepts of 8086 processor.
3. To expose the students to various interfacing devices with 8086.
4. To introduce the concepts of interrupt mechanism.
5. To understand various interfacing and applications of 8051

COURSE OUTCOMES:

After completion of the course, the students are able to

CO1: Explain the architecture of 8086 microprocessor. **[K2]**

CO2: Demonstrate programming proficiency using Instruction set. **[K2]**

CO3: Analyze concept of interfacing different peripheral devices with 8086. **[K4]**

CO4: Interpret the memory organization and I/O management of 8051. **[K2]**

CO5: Summarize various interfacing and applications of 8051. **[K2]**

SYLLABUS:

UNIT–I: **8086 MICROPROCESSOR**

Evolution of Microprocessors, Introduction to 8085, Introduction to 8086 Processor, Architecture-Functional diagram, Register Organization, Physical memory organization, signal descriptions of 8086- common function signals, Minimum and Maximum mode signals, Timing diagrams.

UNIT–II: **INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING OF 8086**

Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations. Interrupt structure of 8086, Vector interrupt table, Interrupt service routine.

UNIT–III: **BASIC PERIPHERALS AND THEIR INTERFACING**

8255 PPI various modes of operation and interfacing to 8086. Interfacing Keyboard, Display, Stepper Motor Interfacing.

UNIT–IV: 8051 MICROCONTROLLER

Microprocessors vs. Microcontrollers. Overview of 8051 microcontroller, Architecture, I/O Ports, Memory organization, addressing modes and instruction set of 8051, Interrupts, timer/ Counter and serial communication.

UNIT–V: INTERFACING OF 8051

Interfacing 8051 to LEDs, LCD and Keyboard Interfacing, Interfacing Seven segment display.

TEXT BOOKS:

1. A. K. Ray, K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH, 2000.

2. D. V. Hall' "Microprocessors and Interfacing", 3rd Edition, Mc Graw Higher Ed, 2012.

3. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.Mc Kinlay, "The 8051 Microcontrollers and Embedded Systems", 2nd Edition, Pearson, 2007.

REFERENCE BOOKS:

1. Barry B. Brey, Intel Microprocessors, 7th Edition, PHI, 2006.

2. Liu and GA Gibson, Micro Computer System 8086/8088 Family Architecture. Programming and Design, 2nd Edition, PHI, 1985.

3. Kenneth. J. Ayala, 8051 Microcontroller, 3rd Edition, Cengage Learning, 2010.

WEB REFERENCES:

1. http:// http://nptel.ac.in/courses/106108100/
2. https://onlinecourses.nptel.ac.in/noc18_ec03/
3. https://www.electronicshub.org/8051-microcontroller-introduction/
4. https://www.edgefx.in/8051-microcontroller-architecture/

IV B.TECH I SEMESTER (OPEN ELECTIVE - III)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC3OE08	NANO ELECTRONICS						

COURSE OBJECTIVES:

1. To gain knowledge and fundamental concepts of Nano Electronics.
2. To learn characteristics and microscopic structures.
3. To understand the fabrication techniques.
4. To learn the concept of carbon nano structures and its applications.
5. To understand the classification of nano sensors and its applications.

COURSE OUTCOMES:

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

CO1:.Describe the classification of nano structures with energy bands. [K2]

CO2:.Differentiate the scanning probe techniques and diffraction techniques. [K4]

CO3: Compare and contrast Quantum well width fluctuations and thermally annealed quantum well. [K4]

CO4: Summarize the features of carbon clusters and nano tubes. [K2]

CO5:.Differentiate the key features of NEMS and MEMS. [K4]

SYLLABUS:

UNIT–I: INTRODUCTION

Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore's law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale.

UNIT–II: CHARACTERIZATION

Characterization:

Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques.

Inorganic semiconductor nanostructures:

Overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states.

UNIT–III: FABRICATION TECHNIQUES

Requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.

UNIT–IV: CARBON NANOSTRUCTURES

Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes.

UNIT–V: NANOSENSORS

Nanosensors:

Introduction, Order from Chaos, Characterization, Perception, Nanosensors Based On Quantum Size Effects, Electrochemical Sensors, Sensors Based On Physical Properties, Nanobiosensors, Smart dust Sensor for the future.

Applications:

Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS.

TEXT BOOKS:

1. Robert Kelsall, Ian Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley, 2007.

2. Charles P Poole, Jr, Frank J Owens, Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011.

3. T Pradeep, Nano: The essentials-Understanding Nanoscience and Nanotechnology, TMH.

REFERENCE BOOKS:

1. William A Goddard III, Donald W Brenner, Sergey E. Lyshevski and Gerald J Iafrate, Hand Book of Nanoscience Engineering and Technology, CRC Press, 2003.

WEB RESOURCES:

1. http://www.ewh.ieee.org/tc/nanotech/
2. http://www.nano.org.uk
3. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
4. http://www.avs.org
5. http://www.cientifica.eu
6. http://www.euspen.org
7. http://www.foresight.org
8. http://www.nanotec.org.uk
9. http://nanotechweb.org
10. http://www.ostp.gov/nstc/index.html

IV B.TECH I SEMESTER (OPEN ELECTIVE - IV)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC4OE07	INTRODUCTION TO EMBEDDED SYSTEMS (Other than ECE)						

COURSE OBJECTIVES:

1. To gain knowledge and fundamental concepts and basic building blocks of an embedded system
2. To learn characteristics, quality attributes and applications of embedded systems
3. To understand the concept of real time operating systems
4. To learn the RTOS basics and various Communication & Synchronization techniques
5. To understand the classification and applications of embedded systems

COURSE OUTCOMES: After completion of the course, the student will be able to

CO1: Illustrate the classification and applications of embedded systems. **[K3]**

CO2: Classify the memory devices and passive components of embedded systems**. [K4]**

CO3: Summarize various Communication interface in Embedded Systems. **[K2]**

CO4: Summarize the steps involved in developing application specific embedded systems with suitable example. **[K6]**

CO5: Describe the RTOS basics and various Communication & Synchronization techniques. **[K2]**

SYLLABUS:

UNIT–I: INTRODUCTION

Embedded Systems vs. general computing systems, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems.

UNIT–II: CORE AND MEMORY

Core of the embedded system: general purpose and domain specific processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS). Memory: ROM, RAM, memory according to the type of interface, memory shading, memory selection for embedded system.

UNIT–III: COMMUNICATION INTERFACE AND EMBEDDED SYSTEM COMPONENTS

Communication Interface: Onboard and external Communication Interfaces embedded firmware. Embedded system Components: reset circuit, brown-out protection circuit, oscillator unit, Real Time Clock (RTC), watchdog timer, PCB and passive components.

UNIT–IV: CHARACTERISTICS, QUALITY ATTRIBUTES AND EXAMPLES OF EMBEDDED SYSTEMS.

Characteristics of embedded systems and quality attributes of embedded systems. Embedded systems application and domain-specific: washing machine-application-specific embedded system, automotive- domain-specific embedded system.

UNIT–V: RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling. Task communication, task synchronization, task communication/synchronization issues, task synchronization techniques, device drivers, How to choose an RTOS?

TEXT BOOKS:

1. Shibu K.V, Introduction to Embedded Systems, Mc Graw Hill Education, 2013.
2. Raj Kamal, Embedded Systems, TMH, 2007.
3. Tammy Noergaard, Embedded systems Architecture, Elsevier publications, 2005.

REFERENCE BOOKS:

1. Frank Vahid, Tony Givargis, Embedded System Design, John Wiley, 1999.
2. David E. Simon, An Embedded Software Primer, Pearson Education, 1999.

WEB RESOURCES:

1. http://www.embeddedtechnology.com/
2. http://www.omg.org/realtime/
3. http://www.eembc.org
4. http://www.instantweb.com/~foldoc/
5. http://www.realtime-info.be/magazine/98q4/1998q4_p014.pdf
6. http://www.eet.com/
7. http://www.zdnet.com/intweek/

IV B.TECH I SEMESTER (OPEN ELECTIVE - IV)	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC4OE08	EMBEDDED AND REAL TIME OPERATING SYSTEMS						

COURSE OBJECTIVES:

1. To survey the basics of an embedded system.
2. To survey the general structure of a real-time system.
3. To develop task scheduling and task communication algorithms.
4. To develop task synchronization algorithms.
5. To identify the design methods of embedded systems.

COURSE OUTCOMES:

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

CO1: Survey the basics of an embedded system. **[K4]**

CO2: Survey the general structure of a real-time system. **[K4]**

CO3: Develop task scheduling and task communication algorithms. **[K3]**

CO4: Develop task synchronization algorithms. **[K3]**

CO5: Identify the design methods of embedded systems. **[K3]**

SYLLABUS:

UNIT-I: INTRODUCTION TO EMBEDDED SYSTEMS

Embedded system vs. General computing system, classification, major application areas, purpose of embedded systems, core of embedded system, memory, sensors and actuators, communication interface.

UNIT-II: INTRODUCTION TO RTOS

Operating System basics, types, RTOS, Architecture of the Kernel, Kernel objects, tasks/process and threads, Context Switching, Interrupt service routines- Interrupt latency, interrupt response time, interrupt recovery time, How to choose an RTOS?

UNIT-III: TASK SCHEDULING AND TASK COMMUNICATION

Task Scheduling - Types of multitasking, non-preemptive and preemptive scheduling algorithms, Task Communication - shared memory, pipes, memory mapped objects, message passing, message queue, mailbox, signalling, RPC and sockets.

UNIT-IV: TASK SYNCHRONIZATION

Task Communication/Synchronization issues, racing, deadlock, Conditions favoring deadlock situation, deadlock handling, the dining philosopher's problem, Task Synchronization techniques-Semaphore, Mutex,

UNIT-V: DESIGN TECHNOLOGY

Introduction, Automation, Synthesis, Parallel evolution of compilation and synthesis, Logic Synthesis, RT synthesis, Behavioural Synthesis, Systems Synthesis and Hardware/Software Co- Design.

TEXT BOOKS:

1. Introduction to Embedded Systems, Shibu. K.V, TMH, 2009.
2. Embedded / Real Time Systems, KVKK Prasad, Dreamtech Press, 2005.
3. Embedded System Design, A Unified Hardware/Software Introduction, Frank Vahid, Tony D. Givargis, John Wiley, 2002.

REFERENCE BOOKS:

1. 8051 Microcontroller & Embedded Systems using Assembly and C,Ayala & Gadre: Cengage
2. Embedded Systems, Rajkamal, TMH, 2009.
3. Embedded Software Primer, David Simon, Pearson.
4. The 8051 Microcontroller and Embedded Systems, Mazidi, Pearson.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=F321087yYy4
2. https://www.youtube.com/watch?v=JIr7Xm_riRs&list=PLEBQazB0HUyQ4hAPU1cJED6t3DU0h34bz&index=2
3. https://www.youtube.com/watch?v=95yUbClyf3E&list=PLEBQazB0HUyQ4hAPU1cJED6t3DU0h34bz&index=3
4. https://www.youtube.com/watch?v=pHJ3lxOoWeI&list=PLEBQazB0HUyQ4hAPU1cJED6t3DU0h34bz&index=5
5. https://www.youtube.com/watch?v=5JcMtbA9QEE&list=PLEBQazB0HUyQ4hAPU1cJED6t3DU0h34bz&index=7

CSE

R20 OPEN ELECTIVE

OPEN ELECTIVE-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	DBMS (Other Than CSE)	CSE	R20CC1OE10	3	0	0	3
2	Web Development Using Mean Stack Tech.	CSE	R20CC1OE11	3	0	0	3

OPEN ELECTIVE-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Artificial Intelligence	CSE	R20CC2OE09	3	0	0	3
2	OOPS through JAVA	CSE	R20CC2OE10	3	0	0	3

OPEN ELECTIVE-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Cloud Computing	CSE	R20CC3OE09	3	0	0	3
2	Block Chain Technologies	CSE	R20CC3OE10	3	0	0	3

OPEN ELECTIVE-IV

S.No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Cyber Security	CSE	R20CC4OE09	3	0	0	3
2	Ethical Hacking	CSE	R20CC4OE10	3	0	0	3

OPEN ELECTIVE-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC1OE10	DATABASE MANAGEMENT SYSTEMS (OTHER THAN CSE)						

COURSE OBJECTIVE

- Provides students with theoretical knowledge and practical skills in the design, use of databases and database management systems in information technology applications

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Classify various Data models, Architectures and their implications
CO 2: Analyze DB design methodology and normalization process
CO 3: Interpret how queries are being processed and executed in RDBMS
CO 4: Compare the various transaction and concurrency management techniques

SYLLABUS

UNIT- I: INTRODUCTION

Database system, Characteristics - Database vs. File System, Database Users -Actors on Scene, Workers behind the scene; Advantages of Data base systems, and Database applications, Brief introduction of different Data Models - Hierarchical, Network and Relational; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, Centralized and Client Server architecture for the database.

UNIT- II: ENTITY RELATIONSHIP MODEL

Introduction, Representation of entities, attributes, entity set, relationship, relationship set, Key constraints - Key constraints for Ternary Relationships, participation constraints, class hierarchies, Aggregation; sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

RELATIONAL MODEL

Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values - Comparisons Using Null Values, Logical Connectives AND, OR, and NOT, Impact on SQL Constructs, Disallowing Null Values; Integrity constraints in SQL - Domain constraints, Entity constraints, Referential integrity constraints, Assertions.

UNIT- III: SQL

Form of a basic SQL Query, Examples of Basic SQL Queries, Expressions and Strings in the SELECT Command, Simple Database schema, data types, table definitions, different DML operations, basic SQL querying using where clause, arithmetic and logical operations, SQL functions - Date and Time, Numeric, String conversion; Creating tables with relationship, implementation of key and integrity constraints, nested queries, correlated Nested Queries, set- Comparison Operators, sub queries, grouping, aggregate operators, ordering, implementation of different types of joins, view - updatable and non-updatable; relational set operations, SQL constructs that grant access or revoke access from user or user groups.

UNIT- IV: SCHEMA REFINEMENT (NORMALIZATION)

Problems Caused by Redundancy [Null Values], Decompositions, Problems Related to Decomposition, Functional dependency, Properties of Functional dependency, Normal forms based on functional dependency - 1NF, 2NF and 3NF.

Transaction Management: Transaction - Single-User versus Multiuser Systems; Transactions, Database Items, Read and Write Operations, and DBMS Buffers.

UNIT- V: CONCURRENCY CONTROL

Why Concurrency Control Is Needed, Why Recovery Is Needed, Transaction States and Additional Operations, The System Log, Commit Point of a Transaction, properties of transactions, Characterizing Schedules Based on Serializability - Serial, Non serial, Two- Phase Locking Techniques for Concurrency Control - Types of Locks and System Lock Tables, Guaranteeing Serializability by Two-Phase Locking, Dealing with Deadlock and Starvation.

Introduction to Indexing:

Types of Single- Level Ordered Indexes - Primary Indexes, Clustering Indexes, Secondary Indexes.

TEXT BOOKS:

Database Management Systems - Raghuram Krishnan, Johannes Gehrke, TMH, Third Edition, 2003.
Fundamentals of Database Systems - Ramez Elmasri, Shamkant B. Navathe, PEA, Sixth Edition, 2010.

REFERENCE BOOKS:

Database System Concepts - Silberschatz, Korth, TMH, Fifth Edition, 2006.
Introduction to Database Systems - C J Date, PEA, Eighth Edition, 2006.
ADDITIONAL RESOURCES:
nptel.ac.in/courses/106106093
nptel.ac.in/courses/10610413

OPEN ELECTIVE-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC1OE11	WEB DEVELOPMENT USING MEAN STACK TECH						

COURSE OBJECTIVE:

- This course is designed to introduce students to learn how to design both the front and back end of web applications. The course will introduce web-based media-rich programming tools for creating interactive web pages.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1: Apply Angular8 to develop web applications. [K3]

CO2: Make use of Forms and Services. [K3]

CO3: Utilize Node.js to create Server Side Applications. [K3]

CO4: Make use of Express to deploy web applications. [K3]

CO5: Experiment with NoSQL using MongoDB. [K3]

SYLLABUS

Unit-I: Angular8

Introduction, Installation, Creating First Angular8 Application, Architecture, Angular Components and Templates, Data Binding, Directives, Pipes, Services and Dependency Injection.

Unit-II

Angular8: Reactive Programming, Http Client Programming, Angular Material, Routing and Navigation, Forms, Form Validation, CLI Commands.

Unit-III:

Node.js: Introduction, Git Basic commands, Node.js Process Model, Node.js Console, Node.js Basics, Node.js Modules, Local Modules, Export Module, Node Package Manager, Node.js Web Server.

Unit-IV

Node.js contd. & Express.js: Node.js File System, Debugging Node.js, Node Inspector, Node.js EventEmitter, Frameworks for Node.js. Express.js: Express.js Web App, Serving Static Resources.

Unit-V:

MongoDB: Access MongoDB in Node.js, Connecting MongoDB, Insert Documents, Update/Delete Documents, Query Database, Mangoose.

TEXT BOOKS:

1. Node.js, MongoDB and Angular Web Development by Brad Dayley, Brendan Dayley- 2nd Edition – Addison –Wesley
2. Getting MEAN with Mango, Express, Angular and Node by Simon Holmes, Clive Harber-2nd Edition - Manning Publications.
3. MEAN Cookbook by Nicholas McClay - Packt

REFERENCES BOOKS:

1. Node.js: Web Development for Beginners by Joseph Conner
2. Mean Stack Developer by Camila Cooper

ADDITIONAL RESOURCES:

1. https://www.edx.org/course/introduction-to-mongodb-using-the-mean-stack
2. https://www.simplilearn.com/full-stack-web-developer-mean-stack-certification-training
3. https://www.tutorialsteacher.com/nodejs/expressjs-web-application

OPEN ELECTIVE-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE09	ARTIFICIAL INTELLIGENCE						

COURSE OBJECTIVE:

- The objectives of this course are Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic and learning.
- The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Summarize the characteristics of AI that make it useful to real-world problems.

CO 2: Analyse different search techniques and predicate logic in artificial Intelligence.

CO 3: Interpret knowledge representation and symbolic reasoning using different rules.

CO 4: Apply the basic knowledge on learning .

CO 5: Make use of the power of AI in Natural language processing as an advanced application of AI.

SYLLABUS

UNIT - I

Introduction to AI, Problems, Problem Spaces and Search: Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics, Issues in the Design of Search Programs.

UNIT - II

Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis. Knowledge Representation Using

Predicate Logic: Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution.

UNIT - III

Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

UNIT - IV

Weak slot-and-filler structures: Semantic Nets, Frames, Strong slot-and-filler structures: Conceptual dependency, Scripts

Learning: Rote learning, learning by taking advice, learning in problem solving,

UNIT – V

Natural Language Processing: Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Statistical Natural language Processing, Spell Checking, Parallel and Distributed AI: Parallelism in Reasoning Systems, Distributed Reasoning Systems

TEXT BOOKS:

Elaine Rich & Kevin Knight, 'Artificial Intelligence', 3nd Edition, (Tata McGraw Hill Edition) Reprint 2008

Carl Townsend, 'Introduction to TURBO PROLOG', BPB Publications. 2011

Tom M Mitchell "Machine Learning "(McGraw-Hill Science/Engineering/Math; (March 1, 1997))

REFERENCE BOOKS:

Patrick Henry Winston, 'Artificial Intelligence', Pearson Education, 2003

Russel and Norvig, 'Artificial Intelligence', Pearson Education, PHI, 2003

OPEN ELECTIVE-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE10	OOPS THROUGH JAVA (OTHER THAN CSE AND ECE)						

COURSE OBJECTIVE:
The course provides fundamentals of object-oriented programming in Java and development of user interface.

COURSE OUTCOMES:
After successful completion of this course, the student will be able to:
CO1: Summarize the basic concepts of Object Oriented Programming.
CO2: Illustrate various programming paradigms of Object Oriented Programing.
CO3: Analyze inheritance, packages and Exception handling concepts.
CO4: Apply multi-threading concepts and Applets.
CO5: Apply Event Handling and AWT concepts in various UI Applications.

SYLLABUS:
UNIT - I
Introduction to OOP: Introduction, Need of Object Oriented Programming, Principles of Object-Oriented Languages(Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism), Procedural languages Vs. OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features(Platform Independence, Object-Oriented, Both Java compiled and interpreted, Robust, Security, Multithreaded, other features), and Program structures, Installation of JDK1.8(Getting started with JDK, JDK Installation notes, Exploring the JDK).

UNIT - II
Programming Constructs: Variables, Primitive Data types, Identifiers (Naming Conventions, Keywords), Literals, Operators (Binary, Unary and ternary), Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control (Branching, Conditional, loops).
Classes and Objects: classes, Objects, Creating Objects, Methods (method types, method overloading), constructors (Parameterized Constructors, Constructor overloading), Cleaning up unused objects (Garbage collector, Finalization), Static keyword (static variables, methods, blocks), this keyword, Arrays, Recursion, Command line arguments and String handling.

UNIT - III
Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overriding, super keyword, final keyword, Abstract class.
Interfaces, Packages and Enumeration: Interface (Variables in interface, Extending interface), Interface vs. Abstract classes, Packages (Creating packages, using Packages, Access protection), Understanding CLASSPATH, java.lang package (Object class, String class), enumeration.

Exceptions: Introduction, Exception handling techniques (try...catch, throw, throws, finally block), user defined exception.

UNIT - IV

Multi-Threading: java.lang.Thread, Thread life cycle, main Thread, Creation of new threads (by inheriting Thread class, Implementing the Runnable interface), Thread priority, Multithreading using isAlive () and join (), Synchronization (Synchronizing Methods, Statements), Suspending and Resuming threads, Communication between Threads.
Applets: Applet class, Applet structure, An Example Applet Program, Applet Life Cycle (init (), start (), stop (), destroy ()), paint (), update () and repaint (), passing parameters to the Applet.

UNIT - V

Event Handling: Introduction, Event Delegation Model, java.awt.event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes.
Abstract Window Toolkit: Why AWT?, java.awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar.

TEXT BOOK:

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH.

REFERENCE BOOKS:

1.JAVA Programming, K. Rajkumar, Pearson.
2.Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech.

ONLINE REFERENCES:

- https://www.coursera.org/learn/object-oriented-java
- https://www.youtube.com/watch?v=3u1fu6f8Hto
- https://www.edx.org/course/object-oriented-programming-in-java

OPEN ELECTIVE-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE09	CLOUD COMPUTING						

COURSE OBJECTIVES:

- To gain knowledge about virtualization and Virtual Machines
- To familiarize Cloud Computing and its services

COURSE OUTCOMES:

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

CO1: Interpret various types of Virtualization.
CO2: Outline the Cloud Computing Architectures and Models.
CO3: Analyze the Cloud Infrastructure Management and Migration and Disaster Management in Cloud
CO4: Analyze AWS and MS Azure services.

SYLLABUS

UNIT-I:

Overview of Cloud Computing: Essentials of Cloud Computing, History of Cloud Computing, Business and Information, Benefits of Cloud Computing, Limitations of Cloud Computing, Characteristics of Cloud Computing, How to Develop Cloud Infrastructure, Vendors of Cloud Computing.

UNIT-II:

Introduction to virtualization and virtual machine: Types of virtualization: Server virtualization, Application/ desktop virtualization, client virtualization, storage virtualization, Network virtualization service / application infrastructure virtualization, virtual machines & virtualization middleware.

Cloud Computing Architecture: Grid Framework Overview, Grid Architecture, Cloud Computing Architecture, Key Design Aspects of Cloud Architecture, Cloud Services, and Cloud Applications, Similarities and Differences Between Grid and Cloud Computing, Cloud and Dynamic Infrastructure.

UNIT-III:

Models of Cloud Computing: Cloud Service Models, Cloud Computing Sub Service Models, Cloud Deployment Models, Alternative Deployment Models, Cloud Stack, Cloud Storage.

UNIT-IV:

Cloud Infrastructure Management and Migration: Administrating Clouds, Cloud Management Products, Processes in Cloud Service Management, Cloud Providers and Traditional IT Service Providers, How to Access the Cloud, Migrating to Clouds.

Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management

UNIT-V:

What is Microsoft Azure?, Types of Azure Clouds, Azure key Concepts, Azure Domains (Components), Traditional vs. Azure Cloud Model, Applications of Azure, Advantages of Azure, Disadvantages of Azure. What is AWS?, History of AWS,Important AWS Services , Amazon Web Services Cloud Platform: Compute & Networking , Storage & Content Delivery Network, Database, Analytics, Application Services, Deployment and Management ,Applications of AWS ,services, Companies using AWS, Advantages of AWS, Disadvantages of AWS, Comparison between Azure and AWS.

TEXT BOOKS:

1. Cloud Computing –Shailendra Singh Oxford University Press.

REFERENCE BOOKS:

1. Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide David S. Linthicum Addison-Wesley Professional.
2. Distributed & Cloud Computing From Parallel Processing to the Internet of Things by Kai Hwang. Geoffrey C. Fox. Jack J. Dongarra

ONLINE REFERENCES:

1. http://nptel.ac.in/courses/106106129/21
2. https://freevideolectures.com/course/3649/cloud-computing
3. https://www.youtube.com/watch?v=Eg4AAGCE7X4&list=PL2UlrhJ_JwyA5IlOCdEWlNArFke4jgtlg

OPEN ELECTIVE-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE10	BLOCKCHAIN TECHNOLOGIES						

COURSE OBJECTIVES:

Introduces the fundamental concepts and functionalities of Blockchain.

Provide conceptual understanding of methods in securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.

COURSE OUTCOMES:

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

CO 1 : Understand the fundamentals of Blockchain.

CO 2 :Analyze the working of Blockchain.

CO 3 :Understand how business can be easily made with Blockchain.

CO 4 :Understand how Block Chain can be integrated with various current technologies.

CO 5 :Get familiarity about the Blockchain strength in providing solutions.

CO 6 :Investigate and understand the Problems with Blockchain.

SYLLABUS:

UNIT I: Grasping Blockchain Fundamentals:

Tracing Blockchain's Origin, The shortcomings of current transaction systems, The emergence of bitcoin, The birth of blockchain, Revolutionizing the Traditional Business Network, Exploring a blockchain application, Recognizing the key business benefits, Building trust with blockchain.

UNIT II: Taking a Look at How Blockchain Works:

Why It's Called "Blockchain", What Makes a Blockchain Suitable for Business?, Shared ledger, Permissions, Consensus, Smart contracts ,Identifying Participants and Their Roles.

UNIT III: .Propelling Business with Blockchains:

Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility.

UNIT IV: Blockchain in Action: Use Cases:

Financial Services, Commercial financing, Trade finance, Cross-border transactions, Insurance, Government, Supply Chain Management, Healthcare, Electronic medical records Healthcare payments preauthorization.

UNIT V :Hyperledger, a Linux Foundation Project:

Hyperledger Vision, Hyperledger Fabric, How Can IBM Help Developers Innovate With Blockchain? Offering an easily accessible cloud and development platform, Individualized attention and industry

Expertise.

UNIT VI: Problems with Blockchain:

Security and Safeguards, Protection from attackers, Hacks on exchanges, What is stopping adoption?, Scalability problems , Network attacks to destroy bitcoin , Case Study: Failed currencies & blockchain

TEXT BOOK:

1. Blockchain For Dummies®, IBM Limited Edition, Manav Gupta, John Wiley & Sons, Inc.111 River St, Hoboken, NJ 07030-5774

REFERENCES:

1. Swan, Melanie. Blockchain: Blueprint for a new economy. "O'Reilly Media, Inc.", 2015.

2. Gupta, M. "Blockchain For Dummies." (2017).

OPEN ELECTIVE-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE09	CYBER SECURITY						

COURSE OBJECTIVES:

The Cyber security Course will provide the students with foundational Cyber Security principles, Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies. Students will gain insight into the importance of Cyber Security and the integral role of Cyber Security professionals.

COURSE OUTCOMES:

C01. Cyber Security architecture principles
C02. Identifying System and application security threats and vulnerabilities
C03. Identifying different classes of attacks
C04. Cyber Security incidents to apply appropriate response
C05. Describing risk management processes and practices
C06. Evaluation of decision making outcomes of Cyber Security scenarios

SYLLABUS

UNIT- I

Introduction to Cybercrime:

Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? , Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens.

Cyber offenses: How Criminals Plan Them –Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector Cloud Computing.

UNIT –II

Cybercrime Mobile and Wireless Devices:

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT –III

Tools and Methods Used in Cybercrime:

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Phishing and Identity Theft:Introduction, Phishing, IdentityTheft(IDTheft)

UNIT –IV Cybercrimes and Cyber security:
Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards, Practices, The information Security Blueprint, Security education, Training and awareness program, Continuing Strategies.

UNIT –V Understanding Computer Forensics:
Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

TEXT BOOKS:
1.Cyber Security: Understanding Cyber Crimes, Computer Forensics and LegalPerspectives, Nina Godbole, SunitBelapure, Wiley.
2.Principles of Information Security, MichealE.Whitman and Herbert J.Mattord, Cengage Learning.

REFERENCE BOOK:
Information Security, Mark Rhodes, Ousley, MGH.

OPEN ELECTIVE-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE10	ETHICAL HACKING						

COURSE OBJECTIVES:

- To develop ability to quantitatively assess and measure threats to information assets
- Evaluate where information networks are most vulnerable and perform penetration tests into secure networks for evaluation purposes
- Critique security plans designed at protecting data assets against attacks from the Internet and investigate and mitigate data risk

COURSE OUTCOMES:

After completion of this course, the students would be able to:

CO1: Classify the elements of information security and its challenges and role of security and penetration testing [K2]

CO2: Analyze different attacks and hacking methods [K4]

CO3: Exemplify different techniques in hacking [K2]

CO4: Apply Ethical hacking techniques and understand the Ethical Hacking Laws [K3]

SYLLABUS:

UNIT - I:

ETHICAL HACKINFG: Types of Data Stolen, Elements of Information Security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Types of Hackers, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

UNIT - II:

FOOT PRINTING AND SOCIAL ENGINEERING: Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

UNIT - III:

DATA SECURITY & FIREWALLS: Physical Security – Attacks and Protection, A study on various attacks – Input validation attacks – SQL injection attacks – Buffer overflow attacks - Privacy attacks, Attacks and Measures, Wireless Hacking, Windows Hacking, Linux Hacking.

UNIT - IV:

NETWORK PROTECTION SYSTEM & HACKING WEB SERVERS: Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

UNIT - V:

ETHICAL HACKING LAWS AND TESTS : An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing.

TEXT BOOKS:

1. Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.
2. Kenneth C.Brancik, "Insider Computer Fraud", Auerbach Publications Taylor & Francis, Group 2008.
3. Ankit Fadia, "Ethical Hacking", Second Edition Macmillan India Ltd, 2006.

REFERENCE BOOKS:

1. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series –Elsevier, August 4, 2011.Whitaker & Newman, "Penetration Testing and Network Defence", Cisco Press, Indianapolis, IN, 2006.

CSE (AI)

OPEN ELECTIVE-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	OOP Through JAVA	AI	R20CC1OE15	3	0	0	3
2	Computer Organization	AI	R20CC1OE16	3	0	0	3

OPEN ELECTIVE-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Database Management Systems	AI	R20CC2OE15	3	0	0	3
2	Cloud Computing	AI	R20CC2OE16	3	0	0	3

OPEN ELECTIVE-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Block Chain Technologies	AI	R20CC3OE15	3	0	0	3
2	Human Computer Interaction	AI	R20CC3OE16	3	0	0	3

OPEN ELECTIVE-IV

S.No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	DevOps	AI	R20CC4OE015	3	0	0	3
2	E-Commerce	AI	R20CC4OE016	3	0	0	3

O E- I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC1OE15	**OOPS Through JAVA**						

COURSE OBJECTIVE:

The course provides fundamentals of object-oriented programming in Java and development of user interface.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1: Summarize the basic concepts of Object Oriented Programming.

CO2: Illustrate various programming paradigms of Object Oriented Programing.

CO3: Analyze inheritance, packages and Exception handling concepts.

CO4: Apply multi-threading concepts and Applets.

CO5: Apply Event Handling and AWT concepts in various UI Applications.

SYLLABUS:

UNIT – I Introduction to OOP:

Introduction, Need of Object Oriented Programming, Principles of Object-Oriented Languages(Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism), Procedural languages Vs. OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features(Platform Independence, Object-Oriented, Both Java compiled and interpreted, Robust, Security, Multithreaded, other features), and Program structures, Installation of JDK1.8(Getting started with JDK, JDK Installation notes, Exploring the JDK).

UNIT – II Programming Constructs:

Variables, Primitive Data types, Identifiers (Naming Conventions, Keywords), Literals, Operators (Binary, Unary and ternary), Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control (Branching, Conditional, loops).

Classes and Objects: classes, Objects, Creating Objects, Methods (method types, method overloading), constructors (Parameterized Constructors, Constructor overloading), Cleaning up unused objects (Garbage collector, Finalization), Static keyword (static variables, methods, blocks), this keyword, Arrays, Recursion, Command line arguments and String handling.

UNIT – III Inheritance:

Types of Inheritance, Deriving classes using extends keyword, Method overriding, super keyword, final keyword, Abstract class.

Interfaces, Packages and Enumeration: Interface (Variables in interface, Extending interface), Interface vs. Abstract classes, Packages (Creating packages, using Packages, Access protection), Understanding CLASSPATH, java.lang package (Object class, String class), enumeration.

Exceptions: Introduction, Exception handling techniques (try...catch, throw, throws, finally block), user defined exception.

UNIT – IV Multi-Threading:

java.lang.Thread, Thread life cycle, main Thread, Creation of new threads (by inheriting Thread class, Implementing the Runnable interface), Thread priority, Multithreading using isAlive () and join (), Synchronization (Synchronizing Methods, Statements), Suspending and Resuming threads, Communication between Threads.

Applets: Applet class, Applet structure, An Example Applet Program, Applet Life Cycle (init ()**,** start (), stop (), destroy ()), paint (), update () and repaint (), passing parameters to the Applet.

UNIT – V Event Handling:

Introduction, Event Delegation Model, java.awt.event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes.

Abstract Window Toolkit: Why AWT?, java.awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar.

TEXT BOOK:

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH.

REFERENCE BOOKS:

1. JAVA Programming, K. Rajkumar, Pearson.
2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech.

ONLINE REFERENCES:

1. https://www.coursera.org/learn/object-oriented-java
2. https://www.youtube.com/watch?v=3u1fu6f8Hto
3. https://www.edx.org/course/object-oriented-programming-in-java

O E- I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC1OE16	**COMPUTER ORGANIZATION**						

COURSE OBJECTIVES:

- Comprehensive knowledge of computer system including the analysis and design of components of the system.
- Describes different parameters of a memory system, organization and mapping of various types of memories.
- Illustrates algorithms for basic arithmetic operations using binary representation.
- Describes the means of interaction of devices with CPU, their characteristics and operating modes.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Interpret the computer system from user's perspective and can explain how Arithmetic Logic Unit works. [K2]

CO 2: Explain of basic components of the system and illustrate data paths and control flow for sequencing in CPUs. [K2]

CO 3: Interpret the Micro operations and Microprogramming for design of control unit of CPU. [K2]

CO 4: Develop Main Memory Interfacing Circuit and can apply various cache memory mapping techniques. [K3]

CO 5: Apply algorithms to perform arithmetic operations on binary representation of fixed point data. [K3]

CO 6: Interpret various I/O interface devices. [K2]

SYLLABUS:

UNIT - I Introduction:

Types of Computers, Functional units of Basic Computer (Block diagram of Micro Computer).

Register Transfer and Micro-operations: Register Transfer language, Register Transfer, Bus and memory transfers - Three-State Bus Buffers, Memory Transfer; Arithmetic micro operations, Binary Adder, Binary Adder _Subtractor, Binary Incrementer, Arithmetic Circuit; Logical micro operations-

List of Logic Microoperations, Hardware Implementation, Some Applications; Shift micro operations-Hardware Implementation, Arithmetic logic shift unit.

UNIT - II Basic Computer Organization and Design:

Instruction codes – Stored Program Organization, Indirect Address, Computer Registers – Common Bus Systems, Computer instructions – Instruction Set Completeness, Timing and control, Instruction cycle – Fetch and Decode, Determine the Type of Instruction, Register Reference Instructions, Memory – Reference Instructions – AND to AC, ADD to AC, LDA :Load to AC,STA: Store AC, BUN: Branch Unconditionally, BSA: Branch and Save Return Address, ISZ: Increment and Skip if Zero, Control Flow Chart, Input – Output Instructions and Interrupt – Input – Output Configuration, Input-Output Instructions.

UNIT - III Central Processing Unit:

Instruction formats – Three Address Instructions, Two Address Instructions, One Address Instructions, Zero Address Instructions, RISC Instructions, Addressing modes – Numerical Example, Data Transfer and manipulation – Data Transfer Instructions, Data Manipulation Instructions, Arithmetic Instructions, Logical and Bit Manipulation Instructions, Shift Instructions, Program control – Status Bit Conditions, Conditional Branch Instructions, Subroutine Call and Return, Program Interrupt, Types of Interrupts, Reduced Instruction Set Computer – CISC Characteristics, RISC Characteristics. Micro Programmed Control Unit: Control memory, Address sequencing – Conditional Branching, Mapping of Instructions, Subroutines, Micro program example – Computer Configuration, Microinstruction Format, Symbolic Microinstructions, The Fetch Routine, Symbolic Microprogram, Design of control unit – Microprogram Sequencer.

UNIT - IV The Memory System:

Memory Hierarchy, Main memory - RAM and ROM Chips, Memory Address Maps, Memory Connection to CPU, Auxiliary memory – Magnetic Disks, Magnetic Tape, Associative Memory – Hardware Organization, Match Logic, Cache Memory – Associative Mapping, Direct Mapping, Set-Associative Mapping, Writing into Cache. Computer Arithmetic: Addition and subtraction – Addition and Subtraction with Signed Magnitude Data, Hardware Implementation, Hardware Algorithm, Addition and Subtraction with Signed 2’s Complement Data, Multiplication Algorithms –Booth Multiplication Algorithm.

UNIT – V Input-Output Organization:

Peripheral Devices – ASCII Alphanumeric Characters, Input Output Interface – I/O Bus and Interface Modules, I/O vs Memory Bus, Isolated vs Memory Mapped I/O, Example of I/O Interface, Asynchronous data transfer – Strobe Control, Handshaking, Asynchronous Serial Transfer, Modes of Transfer – Example of Programmed I/O, Interrupt Initiated I/O, Priority Interrupts – Daisy Chaining Priority, Parallel Priority Interrupt, Priority Encoder, Interrupt Cycle, Direct memory Access – DMA Controller, DMA Transfer.

TEXT BOOKS:

1. M. Morris Mano, "Computer System Architecture", Third Edition, Pearson.2008

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw Hill, 5/e, 2002.
2. William Stallings, "Computer Organization and Architecture", Pearson 6/e, 2006.
3. Structured Computer Organization, Andrew S. Tanenbaum, Pearson, 4/e, 2005.
4. Sivarama P. Dandamudi, "Fundamentals of Computer Organization and Design", Springer, 2006.

WEB REFERENCES:

1. nptel.ac.in/courses/106106092
2. nptel.ac.in/courses/106103068

O E- II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE15	**DATABASE MANAGEMENT SYSTEMS**						

COURSE OBJECTIVE:

- Provides students with theoretical knowledge and practical skills in the design, use of databases and database management systems in information technology applications.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1 : Interpret the fundamentals of DBMS. [K2]

CO2 : Analyze DB design methodology and normalization process. [K4]

CO3 : Develop Queries in RDBMS. [K3]

CO4 : Compare and Contrast various transaction and concurrency management techniques. [K2]

CO5 : Analyze various file organizations and indexing techniques. [K4]

SYLLABUS:

UNIT I: Introduction:

History of Data base Systems, Data base System Applications, purpose of database systems, View of Data, Database Languages, Database Access from applications Programs, data base System Structure, data base Users and Administrators, Transaction Management, Storage Manager, the Query Processor.

UNIT-II: Introduction to Database Design:

Data base design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Case Study .

The Relational Model: Introduction to the Relational Model, Integrity Constraint Over relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design ER to Relational, Introduction to Views, Destroying /altering Tables and Views.

UNIT III: Relational Algebra: Relational Algebra. **SQL: Queries, Constraints, Triggers:-** Form of Basic SQL Query, Union, Intersect and Except, Nested Queries, Aggregative Operators, NULL values, Complex Integrity Constraints in SQL, Triggers and Active Data bases.

UNIT IV: Schema Refinement and Normal Forms:

Introduction to Schema Refinement, Functional Dependencies, reasoning about FDS, FIRST, SECOND and THIRD Normal forms, BCNF, Properties of Decomposition, Multi valued Dependencies, FOURTH Normal Form.

UNIT V:Transactions Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation.

Concurrency Control: L

ock-based protocols, Timestamp-based protocols.

Overview of Storage and Indexing:

Data on External Storage, File Organization and Indexing, Index data Structures

Tree Structured Indexing: Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic index Structure.

TEXT BOOKS:

1. Raghuram Krishnan, Johannes Gehrke, "Database Management Systems", TMH, 3/e, 2008.
2. Silberschatz, Korth, "Database System Concepts", TMH, 6/e, 2010.

REFERENCE BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", PEA, 6/e, 2011.
2. C J Date, "Introduction to Database Systems", PEA, 8/e, 2006.
3. Database System Concepts, Peter ROB, Coronel, Ceneage, 6/2, 2011.

WEB REFERENCES:

1. nptel.ac.in/courses/106106093
2. nptel.ac.in/courses/106104135

O E- II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE16	**CLOUD COMPUTING**						

COURSE OBJECTIVES:

- To gain knowledge about virtualization and Virtual Machines
- To familiarize Cloud Computing and its services

COURSE OUTCOMES:

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

CO1: Interpret various types of Virtualization.[K2]

CO2: Outline the Cloud Computing Architectures and Models.[K2]

CO3:Analyze the Cloud Infrastructure Management and Migration and Disaster Management in Cloud.[K4]

CO4: Analyze AWS and MS Azure services.[K4]

SYLLABUS:

UNIT-I: Overview of Cloud Computing:

Essentials of Cloud Computing, History of Cloud Computing, Business and Information, Benefits of Cloud Computing, Limitations of Cloud Computing, Characteristics of Cloud Computing, How to Develop Cloud Infrastructure, Vendors of Cloud Computing.

UNIT-II: Introduction to virtualization and virtual machine:

Types of virtualization: Server virtualization, Application/ desktop virtualization, client virtualization, storage virtualization, Network virtualization service / application infrastructure virtualization, virtual machines & virtualization middleware.

Cloud Computing Architecture: Grid Framework Overview, Grid Architecture, Cloud Computing Architecture, Key Design Aspects of Cloud Architecture, Cloud Services, and Cloud Applications, Similarities and Differences Between Grid and Cloud Computing, Cloud and Dynamic Infrastructure.

UNIT-III: bModels of Cloud Computing:

Cloud Service Models, Cloud Computing Sub Service Models, Cloud Deployment Models, Alternative Deployment Models, Cloud Stack, Cloud Storage.

UNIT-IV: Cloud Infrastructure Management and Migration:

Administrating Clouds, Cloud Management Products, Processes in Cloud Service Management, Cloud Providers and Traditional IT Service Providers, How to Access the Cloud, Migrating to Clouds.

Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management

UNIT-V:

What is Microsoft Azure?, Types of Azure Clouds, Azure key Concepts, Azure Domains (Components), Traditional vs. Azure Cloud Model, Applications of Azure, Advantages of Azure, Disadvantages of Azure. What is AWS?, History of AWS,Important AWS Services , Amazon Web Services Cloud Platform: Compute & Networking , Storage & Content Delivery Network, Database, Analytics, Application Services, Deployment and Management ,Applications of AWS ,services, Companies using AWS, Advantages of AWS, Disadvantages of AWS, Comparison between Azure and AWS.

TEXT BOOKS:

1. Cloud Computing –Shailendra Singh Oxford University Press.

REFERENCE BOOKS:

1. Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide David S. Linthicum Addison-Wesley Professional.

2. Distributed & Cloud Computing From Parallel Processing to the Internet of Things by Kai Hwang. Geoffrey C. Fox. Jack J. Dongarra

WEB REFERENCES:

1. http://nptel.ac.in/courses/106106129/21

2. https://freevideolectures.com/course/3649/cloud-computing

3. https://www.youtube.com/watch?v=Eg4AAGCE7X4&list=PL2UlrhJ_JwyA5IlOCdEWlNArFke4jgtlg

O E- III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE15	**BLOCK CHAIN TECHNOLOGIES**						

COURSE OBJECTIVES:

- Introduces the fundamental concepts and functionalities of Blockchain.
- Provide conceptual understanding of methods in securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.

COURSE OUTCOMES:

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

CO 1 : Summarize the fundamentals of Blockchain.[K2]

CO 2 : Analyze the working of Blockchain.[K4]

CO 3 : Interpret how business can be easily made with Blockchain.[K4]

CO 4 : Summarize how Block Chain can be integrated with various current technologies.[K2]

CO 5 : Get familiarity about the Blockchain strength in providing solutions.[K3]

CO 6 : Investigate and understand the Problems with Blockchain.[K4]

SYLLABUS:

UNIT- I: Grasping Blockchain Fundamentals:

Tracing Blockchain's Origin, The shortcomings of current transaction systems, The emergence of bitcoin, The birth of blockchain, Revolutionizing the Traditional Business Network, Exploring a blockchain application, Recognizing the key business benefits, Building trust with blockchain.

UNIT- II:Taking a Look at How Blockchain Works:

Why It's Called "Blockchain", What Makes a Blockchain Suitable for Business?, Shared ledger, Permissions, Consensus, Smart contracts ,Identifying Participants and Their Roles.

UNIT- III: .Propelling Business with Blockchains:

Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility.

UNIT- IV: Block chain in Action:

Use Cases:Financial Services, Commercial financing, Trade finance, Cross-border transactions, Insurance, Government, Supply Chain Management, Healthcare, Electronic medical records Healthcare payments preauthorization.

UNIT- V Hyperledger, a Linux Foundation Project:

Hyperledger Vision, Hyperledger Fabric, How Can IBM Help Developers Innovate With Blockchain? Offering an easily accessible cloud and development platform, Individualized attention and industry Expertise. **Problems with Blockchain**: Security and Safeguards, Protection from attackers, Hacks on exchanges, What is stopping adoption?, Scalability problems , Network attacks to destroy bitcoin , Case Study: Failed currencies & blockchain

TEXT BOOK:

1. Blockchain For Dummies®, IBM Limited Edition, Manav Gupta, John Wiley & Sons, Inc.111 River St, Hoboken, NJ 07030-5774

REFERENCES:

1. Swan, Melanie. Blockchain: Blueprint for a new economy. "O'Reilly Media, Inc.", 2015.
2. Gupta, M. "Blockchain For Dummies." (2017).

O E- III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE16	**HUMAN COMPUTER INTERACTION**						

COURSE OBJECTIVES:

- The main objective is to get student to think constructively and analytically about how to design and evaluate interactive technologies.

COURSE OUTCOMES:

CO 1:Outline knowledge about user interface design. [K2]

CO 2 Summarize the importance of Graphical User Interface. [K2]

CO 3 Apply the strategies used in design process. [K3]

CO 4 Summarize the importance of screen designing. [K2]

CO 5 Apply the various operations of Windows. [K3]

SYLLABUS

UNIT – I

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

UNIT – II

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT – III

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds.

UNIT – IV

Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics.

UNIT – V

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls.

Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Goryd, Abowd, Russell Beal, "Human Computer Interaction", PEA, 3/e, 2004.
2. Wilbert O Galitz, "The Essential guide to user interface design", Wiley Dream tech, 2/e.

REFERENCE BOOKS:

1. Dan R.Olsan, "Human Computer", Interaction Cengage ,2010.
2. Ben Shneidermann , "Designing the user interface", 4/e, PEA.
3. Soren Lauesen, "User Interface Design", PEA.
4. Prece, Rogers, Sharps, "Interaction Design", Wiley.

WEB REFERENCES:

1. https://scholar.google.co.in/scholar?q=human+computer+interaction&hl=en&as_sdt=0&as_vis=1&oi=scholar
2. https://www.interaction-design.org/literature/topics/human-computer-interaction
3. https://en.wikipedia.org/wiki/Human%E2%80%93computer_interaction
4. https://www.tutorialspoint.com/human_computer_interface/human_computer_interface_introduction.htm

O E- IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE15	**DEVOPS**						

COURSE OBJECTIVES:

•DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance

COURSE OUTCOMES:

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

CO 1: Demonstrate the phases of software development life cycle. [K2]

CO 2: Outline the basic Fundamentals of DevOps. [K2]

CO 3: Adopt the DevOps technology into the project. [K6]

CO 4: Evaluate the CI/CD concepts and metrics to track CI/CD practices. [K5]

CO 5: Summarize the importance of DevOps maturity models. [K2]

SYLLABUS:

UNIT- I

Phases of Software Development life cycle. Values and principles of agile software development.

UNIT- II

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of Applications, DevOps delivery pipeline, DevOps eco system.

UNIT- III

DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack Implementation, People aspect, processes

UNIT- IV

CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices

UNIT- V

Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity Model, DevOps maturity Assessment.

TEXT BOOKS:

1. Gene Kim , John Willis , Patrick Debois, "The DevOPS Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations" Jez Humb,O'Reilly Publications
2. Mike Loukides, "What is Devops? Infrastructure as code" O'Reilly publications.
3. Jez Humble and David Farley, "Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation",
4. Dave Harrison, Knox Lively, "Achieving DevOps: A Novel About Delivering the Best of Agile, DevOps, and Microservices.
5. Joakim Verona , Packt, "Practical Devops"

REFERENCE BOOKS:

1. Mandi Walls, "Building a DevOps Culture", O'Reilly publications
2. Viktor Farcic, "The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline With Containerized Micro services"

WEB REFERENCES:

1. https://www.youtube.com/watch?v=hQcFE0RD0cQ
2. https://www.youtube.com/watch?v=YSkDtQ2RA_c
3. https://www.svrtechnologies.video/courses/devops-training-free/lectures/10955807
4. https://www.youtube.com/watch?v=MOZMw5_fBFA

O E- IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE16	**E-COMMERCE**						

COURSE OBJECTIVE:

- To introduce the fundamental principles of e-business, e-commerce, and the role of management.
- To introduce the application of tools and services to the development of small-scale e- commerce applications

COURSE OUTCOMES:

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

CO 1: Interpret the E-commerce applications and Process Model. [K2]

CO 2: Compare and contrast various electronic Payment Systems. [K3]

CO 3: Interpret the Intra Organizational Commerce. [K2]

CO 4: Outline the corporate digital library and marketing research. [K2]

CO 5: Analyze resource discovery and information filtering. [K4]

SYLLABUS:

UNIT – I

Electronic Commerce-Framework, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications.

UNIT – II

Consumer Oriented Electronic commerce - Mercantile Process models.

Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems.

UNIT – III

Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.

UNIT – IV

Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses.

Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research.

UNIT – V

Consumer Search and Resource Discovery - Information search and Retrieval, Commerce Catalogues, Information Filtering. Digital Video and electronic Commerce

TEXT BOOKS:

1. Kalakata, Whinston, "Frontiers of electronic commerce", Pearson.

REFERENCE BOOKS:

1. Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley, "E-Commerce fundamentals and applications"
2. S.Jaiswal – Galgotia, "E-Commerce".
3. Efrain Turbon, Jae Lee, David King, H.Michael Chang, "E-Commerce".
4. Gary P.Schneider, "Electronic Commerce", Thomson.
5. E-Commerce – Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico Traver.

WEB REFERENCES:

1.https://www.slideshare.net/kamalgulati7/full-notes-on-ecommerce-study-material-for- ecommerce
2.http://www.vssut.ac.in/lecture_notes/lecture1428551057.pdf
3.https://www.geektonight.com/e-commerce-notes/

IT

LIST OF OPEN ELECTIVES OFFERED BY DEPARTMENT

OPEN ELECTIVE-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Front End UI and Frame Work	IT	R20CC1OE10	3	0	0	3
2	Web Development Using Mean Stack Tech	IT	R20CC1OE12	3	0	0	3

OPEN ELECTIVE-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Introduction to AI	IT	R20CC2OE11	3	0	0	3
2	OOP Through JAVA	IT	R20CC2OE12	3	0	0	3

OPEN ELECTIVE-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Digital Marketing	IT	R20CC3OE11	3	0	0	3
2	Augmented Reality	IT	R20CC3OE12	3	0	0	3

OPEN ELECTIVE-IV

S.No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No.of periods per week			No.of Credits
				L	T	P	C
1	Ethical Hacking	IT	R20CC4OE011	3	0	0	3
2	E-Commerce	IT	R20CC4OE012	3	0	0	3

O E- I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUB CODE: R20CC1OE10	**FRONT END UI AND FRAMEWORK**						

COURSE OBJECTIVES:

- To gain the knowledge of techniques associated with the World Wide Web.
- To understand how to use Web-based media-rich programming tools for creating interactive web pages.

COURSE OUTCOMES:

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

CO 1: Analyze a web page and identify its elements and attributes of HTML5.
CO 2: Apply Cascading Styles sheets to design web pages.
CO 3: Build dynamic web pages using Java Script.
CO 4: Build interactive web pages with jQuery.

SYLLABUS:

UNIT - I

HTML5 Basic Tags, Text Formatted Tags, Lists, Tables, Images, Colors, Forms, HTML5 Canvas, HTML5 SVG, HTML5 Media.

UNIT - II

Cascading Style Sheets: Styling Text, Color, Background, Images, Styling Links, Understanding the CSS Box Model and Positioning, Creating Fixed or Liquid Layouts, Using CSS to Design Navigation.

UNIT - III

Introduction to Java Script: General Syntactic Characteristics, Primitives, Control Statements. Objects in Java Script, Dynamic HTML with Java Script: Positioning elements, Moving Elements. Regular Expressions in Java Script: Pattern matching using regular expressions,Working with Events: onload, onclick, onsubmit, onmouseover, onmouseout, onkeydown, onkeyup, onkeypress.

UNIT - IV

JQuery API: Introduction: What jQuery can Do, Who Develops jQuery? Obtaining jQuery Programming Conventions, Markup and CSS Conventions, JavaScript Conventions. Events: The Various Event Wrapper Methods, Attaching Other Events, Attaching Persistent Event Handlers, Removing Event Handlers. Manipulating Content and Attributes:Setting, Retrieving, and Removing Attributes, Manipulating HTML and Text Content. Iteration of Arrays and objects: Enumerating Arrays, Filtering Selections and Arrays, Mapping a Selection or an Array, Array Utility Methods.

UNIT - V

JQuery UI: Animations and Effects: Showing and Hiding Elements, Sliding Elements, Fading Elements, Custom Animation, Animation Options. HTML5 Drag and Drop: Implementing Drag and Drop. Sortable: Making a List Sortable, Customizing Sortable, Saving the State of Sorted Lists. Date picker: Implementing a Date picker, Localizing the Date picker

TEXT BOOKS:

1. Kogent leaning solutions Inc, "Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book", ISBN: 978-93-5004-593-0,Dream Tech,2013.
2. Robert W Sebesta," Programming the World Wide Web", ISBN 10:1-292-02431-3, Pearson, 7th edition,2014.
3. Richard York, "Web Development with JQuery", ISBN:978-1-118-86607-8, John Wiley & Sons,2nd Edition,2015.

REFERENCE BOOKS:

1. Paul S Wang, Sanda S Katila, "An Introduction to Web Design, Programming", ISBN- 10: 8131503674, Cengage,2012.
2. Uttam K Roy "Web Technologies", ISBN-10: 9780198066224, Oxford,2010.

WEB REFERENCES:

1. https://www.edx.org/course/html5-css-fundamentals-w3cx-html5-0x-0
2. https://freevideolectures.com/course/3196/jquery
3. https://www.edx.org/course/introduction-to-jquery

O E- I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC1OE12	**WEB DEVELOPMENT USING MEAN STACK TECH**						

COURSE OBJECTIVE:

- This course is designed to introduce students to learn how to design both the front and back end of web applications. The course will introduce web-based media-rich programming tools for creating interactive web pages.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1: Apply Angular8 to develop web applications. [K3]

CO2: Make use of Forms and Services. [K3]

CO3: Utilize Node.js to create Server Side Applications. [K3]

CO4: Make use of Express to deploy web applications. [K3]

CO5: Experiment with NoSQL using MongoDB. [K3]

SYLLABUS:

UNIT-I: **Angular8:**

Introduction, Installation, Creating First Angular8 Application, Architecture, Angular Components and Templates, Data Binding, Directives, Pipes, Services and Dependency Injection.

UNIT-II: **Angular8:**

Reactive Programming, Http Client Programming, Angular Material, Routing and Navigation, Forms, Form Validation, CLI Commands.

UNIT-III: Node.js

Introduction, Git Basic commands, Node.js Process Model, Node.js Console, Node.js Basics, Node.js Modules, Local Modules, Export Module, Node Package Manager, Node.js Web Server

UNIT-IV: Node.js contd. & Express.js:

Node.js File System, Debugging Node.js, Node Inspector, Node.js EventEmitter, Frameworks for Node.js. **Express.js:** Express.js Web App, Serving Static Resources.

UNIT-V: MongoDB:

Access MongoDB in Node.js, Connecting MongoDB, Insert Documents, Update/Delete Documents, Query Database, Mangoose.

TEXT BOOKS:

Node.js, MongoDB and Angular Web Development by Brad Dayley, Brendan Dayley- 2nd Edition – Addison –Wesley

Getting MEAN with Mango, Express, Angular and Node by Simon Holmes, Clive Harber- 2nd Edition - Manning Publications.

MEAN Cookbook by Nicholas McClay - Packt

REFERENCES BOOKS:

Node.js: Web Development for Beginners by Joseph Conner

Mean Stack Developer by Camila Cooper

ADDITIONAL RESOURCES:

https://www.edx.org/course/introduction-to-mongodb-using-the-mean-stack

https://www.simplilearn.com/full-stack-web-developer-mean-stack-certification- training

https://www.tutorialsteacher.com/nodejs/expressjs-web-application.

O E- II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE11	**INTRODUCTION TO AI**						

COURSE OBJECTIVE:

- Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic and learning.
- The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Summarize the characteristics of AI that make it useful to real-world problems. [K2]

CO 2: Analyse different search techniques and predicate logic in artificial Intelligence. [K4]

CO 3: Interpret knowledge representation and symbolic reasoning using different rules. [K2]

CO 4: Apply the basic knowledge on learning and reinforcement learning. [K3]

CO 5: Make use of the power of AI in Natural language processing as an advanced Application of AI. [K3]

SYLLABUS:

UNIT – I Introduction to AI, Problems, Problem Spaces and Search:

Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics, Issues in the Design of Search Programs.

UNIT – II Heuristic Search Techniques:

Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis. **Knowledge Representation Using Predicate Logic:** Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution.

UNIT – III Representing Knowledge Using Rules:

Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

Weak slot-and-filler structures: Semantic Nets, Frames, **Strong slot-and-filler structures**: Conceptual dependency, Scripts

UNIT – IV_Learning:

Rote learning, learning by taking advice, learning in problem solving,

Reinforcement Learning: Markov Decision Problem, Q-Learning, Q-Learning Algorithm, temporal difference Algorithm

UNIT – V Natural Language Processing:

Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Statistical Natural language Processing, Spell Checking.

TEXT BOOKS:

1. Elaine Rich & Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Edition, 3rd Edition, Reprint 2008.
2. Artificial Intelligence- Saroj Kaushik, CENGAGE Learning,
3. Carl Townsend, "Introduction to TURBO PROLOG", BPB Publications. 2011
4. Tom M Mitchell, "Machine Learning", McGraw-Hill Science/Engineering/Math, 1997.

REFERENCE BOOKS:

1. Artificial Intelligence- Saroj Kaushik, CENGAGE Learning,
2. Patrick Henry Winston, 'Artificial Intelligence', Pearson Education, 2003
3. Russel and Norvig, 'Artificial Intelligence', Pearson Education, PHI, 2003

WEB REFERENCES

1. https://www.coursera.org/learn/machine-learning
2. https://www.simplilearn.com/big-data-and-analytics/machine-learning
3. https://www.appliedaicourse.com/course/applied-ai-course-online
4. http://nptel.ac.in/courses/106105152

O E- II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC2OE12	**OOPS Through JAVA**						

COURSE OBJECTIVE:
The course provides fundamentals of object-oriented programming in Java and development of user interface.

COURSE OUTCOMES:
After successful completion of this course, the student will be able to:
CO1: Summarize the basic concepts of Object Oriented Programming.
CO2: Illustrate various programming paradigms of Object Oriented Programing.
CO3: Analyze inheritance, packages and Exception handling concepts.
CO4: Apply multi-threading concepts and Applets.
CO5: Apply Event Handling and AWT concepts in various UI Applications.

SYLLABUS:

UNIT – I Introduction to OOP:
Introduction, Need of Object Oriented Programming, Principles of Object-Oriented Languages(Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism), Procedural languages Vs. OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features(Platform Independence, Object-Oriented, Both Java compiled and interpreted, Robust, Security, Multithreaded, other features), and Program structures, Installation of JDK1.8(Getting started with JDK, JDK Installation notes, Exploring the JDK).

UNIT – II Programming Constructs:
Variables, Primitive Data types, Identifiers (Naming Conventions, Keywords), Literals, Operators (Binary, Unary and ternary), Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control (Branching, Conditional, loops).
Classes and Objects: classes, Objects, Creating Objects, Methods (method types, method overloading), constructors (Parameterized Constructors, Constructor overloading), Cleaning up unused objects (Garbage collector, Finalization), Static keyword (static variables, methods, blocks), this keyword, Arrays, Recursion, Command line arguments and String handling.

UNIT – III Inheritance:
Types of Inheritance, Deriving classes using extends keyword, Method overriding, super keyword, final keyword, Abstract class.
Interfaces, Packages and Enumeration: Interface (Variables in interface, Extending interface), Interface vs. Abstract classes, Packages (Creating packages, using Packages,

Access protection), Understanding CLASSPATH, java.lang package (Object class, String class), enumeration.
Exceptions: Introduction, Exception handling techniques (try...catch, throw, throws, finally block), user defined exception.

UNIT – IV Multi-Threading:

java.lang.Thread, Thread life cycle, main Thread, Creation of new threads (by inheriting Thread class, Implementing the Runnable interface), Thread priority, Multithreading using isAlive () and join (), Synchronization (Synchronizing Methods, Statements), Suspending and Resuming threads, Communication between Threads.

Applets: Applet class, Applet structure, An Example Applet Program, Applet Life Cycle (init (), start (), stop (), destroy ()), paint (), update () and repaint (), passing parameters to the Applet.

UNIT – V Event Handling:

Introduction, Event Delegation Model, java.awt.event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes.

Abstract Window Toolkit: Why AWT?, java.awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar.

TEXT BOOK:

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH.

REFERENCE BOOKS:

1. JAVA Programming, K. Rajkumar, Pearson.
2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech.

ONLINE REFERENCES:

1. https://www.coursera.org/learn/object-oriented-java
2. https://www.youtube.com/watch?v=3u1fu6f8Hto
3. https://www.edx.org/course/object-oriented-programming-in-java

O E- III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE11	**DIGITAL MARKETING**						

COURSE OUTCOME:

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

CO1: Develop insight on Current Trends – Digital and Social Statistics (Infographics)

CO2: Analyze the Digital Marketing Platforms like Facebook, Twitter, YouTube etc.

CO3: Analyze the basics of Search Engine Optimization (SEO) and Mobile Marketing

CO4: Design the various strategies involved in Marketing products and Services Digitally.

SYLLABUS:

UNIT-I : Introduction to Digital Marketing-

Evolution of Digital Marketing from traditional to modern era, Role of Internet;Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models.

UNIT-II : Internet Marketing and Digital MarketingMix –

Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix,Impact of digital channels on IMC

Search Engine Advertising:- Pay for Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation

Display marketing: Types of Display Ads, Buying Models, Programmable Digital Marketing, Analytical Tools, YouTube marketing

UNIT-III: Social Media Marketing – Role of Influencer Marketing,Tools & Plan–

Introduction to social media platforms, penetration & characteristics; Building a successful social media marketingstrategy

Facebook Marketing: Business through Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook MarketingTools

Linkedin Marketing: Introduction and Importance of Linkedin Marketing,Framing Linkedin Strategy, Lead Generation throughLinkedin, Content Strategy, Analytics and Targeting

UNIT-IV: Twitter Marketing:

Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing, framing content strategy, Twitter AdvertisingCampaigns

Instagram and Snapchat: Digital Marketing Strategies through Instagram andSnapchat
Mobile Marketing: Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, MobileAdvertising Analytics

UNIT-V: Introduction to SEO, SEM, Web Analytics, MobileMarketing, Trends in Digital Advertising Introduction and need for SEO, How to use internet &search engines; search engine and its working pattern,On-page and off-page optimization, SEO Tactics, Introduction to SEM**Web Analytics:** Google Analytics & Google AdWords; data collectionfor web analytics, multichannel attribution, Universalanalytics, Tracking code, **Trends in digital advertising.**

TEXT BOOKS:

1. Seema Gupta, Digital Marketing, Mc-Graw Hill, 1st Edition- 2017
2. Ian Dodson, The Art of Digital Marketing, Wiley Latest Edition
3. Puneet Singh Bhatia, Fundamentals of Digital Marketing, Pearson, 1st Edition – 2017

REFERENCE BOOKS:

1. Vandana Ahuja, Digital Marketing, Oxford University Press, Latest Edition
2. Philip Kotler, Marketing 4.0: – Moving from Traditional to Digital, Wiley 2017
3. Melissa S. Barker |Donald I. Barker | Nicholas F. Bormann | Debra Zahay | Mary LouRoberts, Social Media Marketing: AStrategic Approach, Cengage Latest Edition
4. Ward Hanson , Kirthi Kalyanam, Internet Marketing & e-Commerce Cengage Latest Edition

WEB REFERENCES:

1 https://learndigital.withgoogle.com/digitalunlocked/
2 https://digitalskills.fb.com/en-in/
3 https://www.hubspot.com/digital-marketing
4 http://www.afaqs.com/
5 https://www.linkedin.com/learning/

O E- III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC3OE12	**AUGMENTED REALITY**						

COURSE OBJECTIVE:

- This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO1: Describe how VR systems work and list the applications of VR.

CO2: Understand the design and implementation of the hardware that enables VR systems tobe built.

CO3: Understand the system of human vision and its implication on perception and rendering.

CO4: Explain the concepts of motion and tracking in VR systems.

CO5: Describe the importance of interaction and audio in VR systems.

SYLLABUS:

UNIT – I Introduction to Virtual Reality:

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output-Visual, Aural & Haptic Displays, Applications of Virtual Reality.

UNIT – II Representing the Virtual World:

Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

UNIT – III The Geometry of Virtual Worlds &The Physiology of Human Vision:

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

UNIT – IV Visual Perception & Rendering:

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates

UNIT – V Motion & Tracking:

Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies

Interaction & Audio: Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

TEXT BOOKS:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016 2.

2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002 3.

3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

REFERENCE BOOKS:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005. 2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.

3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.

4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

WEB REFERENCES

1. http://lavalle.pl/vr/book.html

MOOC COURSES:

2. https://nptel.ac.in/courses/106/106/106106138/
3. https://www.coursera.org/learn/introduction-virtual-reality

O E- IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE11	**ETHICAL HACKING**						

COURSE OBJECTIVES:

- To develop ability to quantitatively assess and measure threats to information assets
- Evaluate where information networks are most vulnerable and perform penetration tests into secure networks for evaluation purposes
- Critique security plans designed at protecting data assets against attacks from the Internet and investigate and mitigate data risk

COURSE OUTCOMES:

After completion of this course, the students would be able to:

CO1: Classify the elements of information security and its challenges and role of security and penetration testing [K2]

CO2: Analyze different attacks and hacking methods [K4]

CO3: Exemplify different techniques in hacking [K2]

CO4: Apply Ethical hacking techniques and Ethical Hacking Laws [K3]

SYLLABUS:

UNIT - I: ETHICAL HACKINFG:

Types of Data Stolen, Elements of Information security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Types of Hackers, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

UNIT - II:

FOOT PRINTING AND SOCIAL ENGINEERING: Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

UNIT - III: DATA SECURITY & FIREWALLS:

Physical Security – Attacks and Protection, A study on various attacks – Input validation attacks – SQL injection attacks – Buffer overflow attacks - Privacy attacks, Attacks and Measures, Wireless Hacking, Windows Hacking, Linux Hacking

UNIT - IV: NETWORK PROTECTION SYSTEM & HACKING WEB SERVERS:

Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer

Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

UNIT - V: ETHICAL HACKING LAWS AND TESTS :

An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing.

TEXT BOOKS:

1. Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.
2. Kenneth C.Brancik, "Insider Computer Fraud", Auerbach Publications Taylor & Francis, Group 2008.
3. Ankit Fadia, "Ethical Hacking", Second Edition Macmillan India Ltd, 2006.

REFERENCE BOOKS:

1. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series –Elsevier, August 4, 2011.Whitaker & Newman, "Penetration Testing and Network Defence", Cisco Press, Indianapolis, IN, 2006.

O E- IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	30	70	100	3
SUBCODE: R20CC4OE12	**E-COMMERCE**						

COURSE OBJECTIVE:

- To introduce the fundamental principles of e-business, e-commerce, and the role of management.
- To introduce the application of tools and services to the development of small-scale e-commerce applications

COURSE OUTCOMES:

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

CO 1: Interpret the E-commerce applications and Process Model. [K2]
CO 2: Compare and contrast various electronic Payment Systems. [K3]
CO 3: Interpret the Intra Organizational Commerce. [K2]
CO 4: Outline the corporate digital library and marketing research. [K2]
CO 5: Analyze resource discovery and information filtering. [K4]

SYLLABUS:

UNIT – I

Electronic Commerce-Framework, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications.

UNIT – II

Consumer Oriented Electronic commerce - Mercantile Process models.
Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems.

UNIT – III

Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.

UNIT – IV

Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses.
Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research.

UNIT – V

Consumer Search and Resource Discovery - Information search and Retrieval, Commerce Catalogues, Information Filtering. Digital Video and electronic Commerce

TEXT BOOKS :

1. Kalakata, Whinston, “Frontiers of electronic commerce”, Pearson.

REFERENCE BOOKS :

1. Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley, “E-Commerce fundamentals and applications”
2. S.Jaiswal – Galgotia, “E-Commerce”.
3. Efrain Turbon, Jae Lee, David King, H.Michael Chang, “E-Commerce”.
4. Gary P.Schneider, “Electronic Commerce”, Thomson.
5. E-Commerce – Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico Traver.

WEB REFERENCES:

1.https://www.slideshare.net/kamalgulati7/full-notes-on-ecommerce-study-material-for-ecommerce
2.http://www.vssut.ac.in/lecture_notes/lecture1428551057.pdf
3.https://www.geektonight.com/e-commerce-notes/