K. S. R. M. College of Engineering - KADAPA

(AUTONOMOUS)

Honours Degree for B. Tech. – R20 Regulations

Department of Civil Engineering

List of Subjects for Honours Degree Course:

S. No.	Subject Code	SUBJECT	L	T	P	IM	EM	CR
1	2092101	Highway Construction and Management	4	0	0	40	60	4
2	2092102	Railway Engineering	4	0	0	40	60	4
3	2092103	Ground Improvement Techniques	4	0	0	40	60	4
4	2092104	Airport Planning and Design	4	0	0	40	60	4
5	2092105	Advanced Foundation Engineering	4	0	0	40	60	4
6	2092106	Soil Dynamics & Machine Foundation	4	0	0	40	60	4
7	2092107	Construction Project Planning & Systems	4	0	0	40	60	4
8	2092108	Finite Element Methods	4	0	0	40	60	4
9	2092109	Environmental Geo-Technology	4	0	0	40	60	4

Important Instructions:

1. Any four courses from above list can be selected by students.
2. The student can complete any two subjects under MOOC/NPTEL and approved by BOS Chairman.
3. Total Credits required to award Minor degree are 20. The four theory subjects must be completed, each subject carries 4 credits (total 16 credits) and two MOOC/NPTEL carries 4 credits.

K. S. R. M. College of Engineering - Kadapa

(AUTONOMOUS)

Honours Degree for R20UG Regulations

Electrical and Electronics Engineering (E.E.E)

List of Subjects for Honours Degree Course:

S. No.	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	20HD201	Energy Auditing & Demand Side Management	PEC	4	0	0	40	60	4
2	20HD202	Power System Deregulation	PEC	4	0	0	40	60	4
3	20HD203	PLC & its Applications	PEC	4	0	0	40	60	4
4	20HD204	Embedded System	PEC	4	0	0	40	60	4
		MOOC Courses (Any Two)							
5	20HD205	Electric Vehicles	PEC	2	0	0	40	60	2
6	20HD206	Smart Grid	PEC	2	0	0	40	60	2
7	20HD207	Industrial Automation & Control	PEC	2	0	0	40	60	2
8	20HD208	SCADA & its Applications	PEC	2	0	0	40	60	2
9	20HD209	DC Micro Grid	PEC	2	0	0	40	60	2
Total Credits									20

** The Student will study any 6 subjects, four subjects each with 4 credits and two subjects through MOOC(SWAYAM/NPTEL) for 8weeks with 2 credits. So, the student should acquire 20 credits to get Honour's Degree.

K. S. R. M. College of Engineering - Kadapa

(AUTONOMOUS)

Honours Degree for R20UG Regulations

Department of Mechanical Engineering

List of Subjects for Honours Degree Course:

S.No	Course Title	No. Credits	Subject Code	Semester	L-T-P
1	Alternative Fuels and Emission Control in Auto motives	4	20HN301	V	4-0-0
2	Automation & Robotics	4	20HN302	V	4-0-0
3	Tool Design	4	20HN303	VI	4-0-0
4	Power Plant Engineering	4	20HN304	VI	4-0-0
5	Non Destructive Testing (NDT)	4	20HN305	VI	4-0-0
6	Ergonomics and Human Factors in Engineering	2	20HN306	VII	MOOC
7	Dynamics of machinery	2	20HN307	VII	MOOC
8	Solar and Wind Energy Systems	2	20HN308	VII	MOOC
9	Computational Fluid Dynamics (CFD)	2	20HN309	VII	MOOC
10	Six Sigma and Lean manufacturing	2	20HN310	VII	MOOC
11	Energy Auditing	2	20HN311	VII	MOOC

Important Instructions:

1. A total of 6 Subjects must be taken.
2. In the above 6 MOOC subjects, the student can select any two subjects under MOOC/NPTEL, the credits for the MOOC/NPTEL subject is two only.
3. Total Credits required to award Minor degree are 20. The four theory subjects must be completed, each subject carries 4 credits (total 16 credits) and two MOOC/NPTEL carries 4 credits.

K. S. R. M. College of Engineering - KADAPA

(AUTONOMOUS)

Honours Degree for B. Tech. – R20 Regulations

Department of Electronics and Communication Engineering

List of Subjects for Honours Degree Course:

S. No.	Subject Code	Subject	L	T	P	IM	EM	Credits
1	2092401	Scientific Computing using MATLAB	4	0	0	40	60	4
2	2092402	Computer System Architecture	4	0	0	40	60	4
3	2092403	Electromagnetic Interference & Compatibility	4	0	0	40	60	4
4	2092404	Analog IC Design	4	0	0	40	60	4
5	2092405	Digital IC Design	4	0	0	40	60	4
6	2092406	Biomedical Signal Processing	4	0	0	40	60	4
7	2092407	Embedded System Design with ARM	4	0	0	40	60	4
8	2092408	Information Theory &Coding	4	0	0	40	60	4
9	2092409	DSP Algorithms & Architectures	4	0	0	40	60	4
10	2092410	Low Power VLSI Design	4	0	0	40	60	4
11	2092411	RF Integrated Circuits	4	0	0	40	60	4
12	2092412	Principles of Signal Estimation for MIMO/ OFDM Wireless Communication	4	0	0	40	60	4
13	2092413	Statistical Signal Processing	4	0	0	40	60	4
14	2092414	Op-Amp Practical Applications: Design, Simulation and Implementation	4	0	0	40	60	4
15	2092415	Multirate DSP	4	0	0	40	60	4
16	2092416	Digital VLSI Testing	4	0	0	40	60	4

Any Four courses from the list given and two MOOC courses each of two credits and approved by BOS chairman are required to complete for Honor Degree

K. S. R. M. College of Engineering - KADAPA

(AUTONOMOUS)

Honours Degree for B. Tech. – R20 Regulations

Department of Computer Science Engineering

List of Subjects for Honours Degree Course:

S.No	Subject Code	Subject Name	Semester	L-T-P	Credits
1	2092501	Data Science	V Sem	4-0-0	4
2	2092502	Computer Architecture and organization	V Sem	4-0-0	4
3	2092503	Applied Machine learning in Python	VI Sem	4-0-0	4
4	2092504	Deep Learning	VI Sem	4-0-0	4
5	2092505	Introduction to Block chain Technologies and Applications	VII Sem	MOOC	2
6	2092506	Big Data and Hadoop	VII Sem	MOOC	2
7	2092507	Introduction to Industry 4.0 and Industrial IOT	VII Sem	MOOC	2
8	2092508	Design and Implementation of Human Computer Interfaces	VII Sem	MOOC	2
9	2092509	Reinforcement Learning	VII Sem	MOOC	2
10	2092510	Ethical Hacking	VII Sem	MOOC	2

Important Instructions:

1. A total of 6 Subjects must be taken.
2. In the above 3 MOOC subjects, the student can select any two subjects under MOOC/NPTEL, the credits for the MOOC/NPTEL subject is two only.
3. Total Credits required to award Honours degree are 20. The four theory subjects must be completed, each subject carries 4 credits (total 16 credits) and two MOOC/NPTEL carries 4 credits.

K. S. R. M. College of Engineering - KADAPA

(AUTONOMOUS)

Honours Degree for B. Tech. – R20 Regulations

Department of Artificial Intelligence & Machine Learning

List of Honor Degree Subjects:

S.No.	Course Code	Course Name	Semester	Hours per Week			IM	EM	Credits
				L	T	P	40	60	
1	20923901	Applied Machine Learning in Python	V Sem	4	0	0	40	60	4
2	20923902	Intelligent Agents	V Sem	4	0	0	40	60	4
3	20923903	Business Intelligence	VI Sem	4	0	0	40	60	4
4	20923904	Design Patterns	VI Sem	4	0	0	40	60	4
5	20923905	Information Theory and Coding	VII Sem	MOOC			---	---	2
6	20923906	Information Retrieval Systems	VII Sem	MOOC			---	---	2
7	20923907	Machine Translation	VII Sem	MOOC			---	---	2
8	20923908	Introduction to Industry 4.0 and Industrial IOT	VII Sem	MOOC			---	---	2
9	20923909	Big Data and Hadoop	VII Sem	MOOC			---	---	2
10	20923910	Federated Machine Learning	VII Sem	MOOC			---	---	2

Note: Students can do any two MOOC from the list given above.

Course Title	Highway Construction and Management				B. Tech. Honours Degree Course		
Course Code	Hours / Week			Credits	Maximum Marks		
2092101	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 1.5Hrs					End Exam Duration : 3Hrs		

Course Objectives: This course is taught to impart the knowledge in highway construction, Bituminous and cement concrete construction, importance of drainage system, maintenance of different roads and highway finance.

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

CO 1	Demonstrate the components of highway construction and its types
CO 2	Design bituminous pavement construction and its Specifications.
CO 3	Identify the importance of drainage systems and erosion control.
CO 4	Do structural evaluation of Flexible pavements.
CO 5	Describe the benefits, economic analysis and financing system in India.

UNIT – I

Highway Construction: General Features of highway construction- Embankment and subgrade construction-construction of Gravel Base- Cement stabilized sub base-WBM bases-Wet mix constructions- Shoulder Constructions.

UNIT – II

Bituminous pavement construction and cement concrete pavement construction

Preparation and laying of tack coat- Bituminous macadam- Penetration macadam- Built up spray Grout- Open Graded Premix- Mix seal- Bituminous concrete- Interface Treatments and overlay construction- IRC Specifications- Introducing mechanical mixers- Pavers- Finishers-Construction of Cement Roads- Manual and Mechanical methods- Joints in concrete and Reinforced concrete pavement and overlay construction- Related equipment.

UNIT – III

Highway Drainage: Objects of Highway drainage system- Requirements and Importance of Highway Drainage- Surface drainage system for Roads- Hydrologic Analysis- Hydraulic Design- Subsurface Drainage- Drainage and Slopes and erosion control- Road construction in water logged areas.

UNIT – IV

Highway Maintenance: Importance of Highway Maintainance works- Deterioration and damages in Road infrastructure- Maintainance requirement in different road components- Distresses in Flexible pavements and Maintainance measures- Structural Evaluation of Flexible pavements and Strengthening by overlay- Benkelman Beam Method.

UNIT – V

Highway Economics and Finance: Introduction- Highway User benefits- General benefits- Quantifiable Benefits- Non Quantifiable Benefits-Highway Costs- Motor Vehicle operation cost- Annual Highway cost- Economic Analysis-Basis of analysis- Method of economic analysis- Annual cost method- Rate of Return Method- Benefit cost Ratio method- Highway Finance- Distribution of Highway cost- Sources of Revenue for the government- Highway Financing in India- Central Road fund.

Text Books

1. S K Khanna, C E G Justo and A Veeraragavan “Highway Engineering”, Nemchand Publications, New Delhi.

References

1. L R Kadiyali “Principles and Practice of Highway Engineering”, Khanna Publishers, New Delhi.
2. Partha Chakroborthy, Animesh Das, “Principles of Transportation Engineering”, Prentice Hall of India, New Delhi.
3. S P Bindra “Highway Engineering”, Dhanpath Rai & Sons, NewDelhi.

Course Title	Railway Engineering				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092102	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration : 1.5Hrs					End Exam Duration : 3Hrs		

Course Objectives:

- To understand the various components of permanent way
- To understand the Geometric design techniques involved in construction of Railway track.
- To know concepts related to signaling and controlling of train movements on the track.

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

CO 1	Understand the components of railway track.
CO 2	Know the dangers of creep and preventive measures in controlling the creep.
CO 3	Get the concepts of geometric design of track.
CO 4	Understand points and crossings.
CO 5	Know the Signalling and controlling systems employed over movements of trains on the track.

UNIT –I

Permanent way: Permanent way: Components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast

UNIT - II

Creep of Rails and Sleepers: Creep of Rails- Indications of creep - Theories related to creep – Effects – measurement and remedies of creep – Sleepers – requirements - Adzing of Sleepers- spacing of sleepers – Sleeper density –Rail Fastenings

UNIT - III

Geometric Design of Railway Track: Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Speed of the train – Curves – necessity – Effects of curvature - Speed on curves - Degree of Curve – Types of curves – Transition curves – Length of transition curve.

UNIT – IV

Points and Crossings: Points and Crossings – Necessity – Turnouts – Left hand turnout – Right hand turnout – switches – crossings – sleepers at points and crossings.

UNIT – V

Signalling and Controlling: Signal Objectives – Classification – Fixed signals – Stop signals – Signalling systems – Mechanical Signalling system – Electrical signalling system – System for Controlling Train Movement – Interlocking – Modern signaling Installations.

Text Books:

1. S.C. Saxena and S.P. Arora "Railway Engineering", Dhanpat Rai Publications.
2. Rangwala "Railway Engineering" Charotar Publishing House Pvt. Ltd.

REFERENCE BOOKS

1. Sateesh Chandra "Railway Engineering" Oxford University Press.

Web Links:

1. https://nptel.ac.in/courses/105107123

Course Title	Ground Improvement Techniques				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092103	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration : 1.5Hrs					End Exam Duration : 3Hrs		

Course Objectives:

- To learn and understand various ground improvement technique.
- To learn various method of compaction for ground improvement in its strength.
- To learn various physical and chemical modification for ground improvement
- To learn the method to choose the foundation and or treatment method based on the site condition

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

CO 1	Select the ground improvement technique which is suitable and economical for soil strengthening.
CO 2	Select different techniques based on the various types of soils in-situ
CO 3	Design reinforced earth structures
CO 4	Exposed to the knowledge on use of geosynthetic material

UNIT – I

In-situ densification methods in granular soils, Vibration at the ground surface, Impact at the Ground surface, Vibration at depth, Impact at depth. In-situ densification methods in cohesive soils, Preloading, Dewatering, Drain wells, Sand drains, Sandwich geodrains, Stone columns, Lime columns, Thermal methods.

UNIT – II

Reinforced earth principles, Components of reinforced earth walls, Factors governing design of reinforced earth walls, Design principles of reinforced earth walls.

UNIT – III

Geotextiles: Introduction, Type of geotextiles, Function and their application, tests for geotextile materials, Geogrids, Functions of geogrids. Expansive soils, Problems in Expansive soils, Mechanism of swelling, swell pressure, swell potential, Heave, Tests for

identification, I. S. Test Methods of determination of swell pressure, Foundation techniques in Expansive soils.

UNIT – IV

Mechanical stabilization: Soil aggregate mixtures, Properties and proportioning techniques, soft aggregate stabilization, compaction, Field compaction control. Cement stabilization: Mechanism-Factors affecting and properties, Uses of additives, Design of soil-cement mixtures, Construction techniques.

UNIT – V

Lime and Bituminous stabilization: Types of admixtures, Mechanism, Factors affecting, Design of mixtures, Construction methods.

Text Books:

1. Dr. P. Purushothama Raj., "Ground Improvement Techniques", Lakshmi Publications Pvt. Ltd.
2. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.
3. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.
4. Koerner, R.M., Designing with Geosynthetics (Third Edition), Prentice Hall, 1997.

Reference Books:

1. Moseley, M.D., Ground Treatment, Blackie Academic and Professional, 1998.
2. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
3. Das, B.M., Principles of Foundation Engineering, (Fourth Edition). PWS Publishing, 1999

Web Links:

1. https://archive.nptel.ac.in/courses/105/105/105105210/
2. https://nptel.ac.in/courses/105108075

Course Title	Airport Planning and Design				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092104	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration : 1.5Hrs					End Exam Duration : 3Hrs		
Course Objectives: The main objective of the course is to expose the students to planning, design, construction and maintenance of airport.							
Course Outcomes: On successful completion of this course, the students will be able to							
CO 1	Understand the importance of airport infrastructure planning and design						
CO 2	Identify the factors governing design of airport infrastructure						
CO 3	Designing of taxi way.						
CO 4	Design of visual aids for airport						
CO 5	Design of airport drainage						

UNIT – I

Airport planning: Objectives - Components, - Airport Classifications – Air transport Characteristics - various surfaces of airport - selection of site – Factors affecting the size of airport - Elements of Runway - Length of Run way, Case studies, Parking and Circulation Area.

UNIT – II

Airport Design: Airport layout - Wind rose diagram - Runway design - Geometric design of runways - Elements of Taxiway design - Airport Zones

UNIT – III

Taxiway Design: Taxiway Marking - Apron, Terminal Building - Passenger facilities, Air traffic control -primary functions of Air Traffic Control, Runway safety - Accidents due to wet runways.

UNIT – IV

Visual Aids: General - Airport lightening system, Airport marking, Instrumental landing system, blast considerations, Temperature.

UNIT – V

Airport Grading and Drainage: General – computation of Earth Work - Airport Drainage - Special characteristics and requirements of Airport Drainage.

Text Books

1. S K Khanna, M G Arora and S S Jain, "Airport Planning and Design", Nem Chand and Bros, Roorkee.

Reference Books

1. Rangwala, "Airport Engineering", Charotar Publishing House, Pvt. Ltd., Gujarat.

Web Links:

1. https://archive.nptel.ac.in/courses/105/107/105107123

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Foundation Engineering</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2092105</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives:
• To explain how the earth pressure acting on sheet pile
• To explain the concepts of braced cuts and how to calculate the lateral pressure at different locations
• To explain the concepts of Terzaghi and IRC Methods and individual components
• To explain the concepts of collapsible and expansive soils and design of foundations
• To explain different methods of ground improvement techniques</td></tr>
<tr><td colspan="8">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Analyse and design the depth of embedment for sheet pile and forces in the anchor.</td></tr>
<tr><td>CO 2</td><td colspan="7">Determine the loads / forces on the struts and bending moment in Wells, sheet piles and design of coffer dam</td></tr>
<tr><td>CO 3</td><td colspan="7">Analyze and design well foundation including complete stability analysis</td></tr>
<tr><td>CO 4</td><td colspan="7">Determine the swell, uplift capacity, and factor of safety</td></tr>
<tr><td>CO 5</td><td colspan="7">Importance and difficulties in stabilization</td></tr>
</table>

UNIT – I

Bulkheads: Types of Sheet Pile Walls – Free Cantilever Sheet Pile – Cantilever Sheet Pile in Cohesionless and Cohesive Soils – Anchored Sheet Pile with Free Earth Support – Rowe's Moment Reduction Curves – Anchored Sheet Pile with Fixed Earth Support – Design of Anchors

UNIT – II

Braced Cuts and Coffer Dams: Introduction – Lateral Earth Pressure on Sheeting's – Different Types of Sheeting and Bracing Systems – Design of Various Components of Bracings.

Coffer Dams – Types of Coffer Dams – Design of Circular Coffer Dams on Rock – Design of Cellular Coffer Dams on Soil.

UNIT – III

Well Foundations: Introduction – Different Shapes of Wells – Grip Length – Forces Acting on the Well Foundation – Terzaghi's Analysis – Banerjee and Gangopadhyay's Analysis – Simplified Analysis for Heavy Wells – IRC Method – Individual Components of the Well – Sinking of Wells – Measures for rectification of Tilts and Shifts.

UNIT – IV

Foundations on Collapsible and Expansive Soils

Collapsible Soils – General Considerations and observations – Computation of Collapse Potential and Settlement – Foundation Design – Treatment Methods.

Expansive Soils – Distribution of Expansive Soils – General Characteristics – Clay Mineralogy and Mechanism of Swelling – Definition of Some Parameters – Evaluation of Swelling Potential of Expansive Soils – Classification of Swelling Soils by Indirect Measurement – Swelling Pressure by Direct Measurements – Effect of Initial Moisture Content and initial Dry Density on Swelling Pressure – Estimating the Magnitude of Swelling – Design of Foundations in Swelling Soils – Elimination of Swelling.

UNIT – V

Soil Stabilization: Introduction – Mechanical Stabilization – Cement Stabilization – Lime Stabilization – Bituminous Stabilization – Chemical Stabilization – Thermal Stabilization – Electrical Stabilization, Stabilization by Grouting – Stabilization by Geo-Textile and Fabrics – Reinforced Earth.

Text Books

1. Dr. K R Arora "Soil Mechanics & Foundation Engineering", Standard Publishers Distributers, New Delhi.
2. V N S Murthy "Advanced Foundation Engineering", C B S Publishers & Distributors, New Delhi.

Reference Books

1. Joseph E. Bowles "Foundation analysis & Design", Tata McGraw-Hill Companies, Inc. New York.
2. Braja M Das "Principles of Foundation Engineering", Thomson Publishers, United States.
3. Dr. P Purushothama Raj "Ground Improvement Techniques", Lakshmi Publications, New Delhi.

Web Links:

1. https://archive.nptel.ac.in/courses/105/105/105105207/

Course Title	Soil Dynamics & Machine Foundation				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092106	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 1.5 Hrs					End Exam Duration : 3Hrs		

Course Objectives:

- To explain the significance of dynamic load in machine foundation analysis
- To explain theory of vibration for different field conditions
- To explain the principles of machine foundation design for reciprocating and impact machines
- To explain the concept and method of foundation isolation

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

CO 1	Analyse and design the depth of embedment for sheet pile and forces in the anchor.
CO 2	Determine the loads / forces on the struts and bending moment in sheet piles and design of coffer dam
CO 3	Analyse and design well foundation including complete stability analysis
CO 4	Determine the swell, uplift capacity, and factor of safety
CO 5	Importance and difficulties in stabilization

UNIT - I

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations.

UNIT – II

Theory of vibration: general definitions - properties of harmonic motion - free vibrations of a mass- spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom.

UNIT – III

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants – methods of determination of soil constants in laboratory and field based on IS code provisions.

UNIT – IV

Vertical, sliding, rocking, and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines - design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method).

UNIT – V

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations.

Text Books

1. Shamsher Prakash, Soil Dynamics, McGraw-Hill, 1981.

Reference Books

1. Alexander Major, Dynamics in Soil Engineering, A Kademiai, 1980.
2. Sreenivasalu and Varadarajan, Handbook of Machine Foundations, Tata McGraw-Hill, 2007.
3. IS 2974 - Part I and II, Design Considerations for Machine Foundations
4. IS 5249: Method of Test for Determination of Dynamic Properties of Soils

Web Links:

1. https://nptel.ac.in/courses/105101005
2. https://archive.nptel.ac.in/courses/105/105/105105221/

Course Title	Construction Project Planning & Systems				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092107	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 1.5Hrs					End Exam Duration : 3Hrs		

Course Objectives:

- Understand the importance of construction management, resources and stages of Planning
- To know how to prepare scheduling in construction activity. significance of PERT and CPM and make use of these two techniques how to develop a network diagram for construction
- To know various types of equipment in construction and applications mechanisation in construction
- Understand importance of inspection and how to maintain quality in different stages. Recognize the Importance of safety measures in construction
- To know the importance of contractual system and carefulness in legal issues during and after the construction.

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

CO 1	Broad View on construction before and after execution
CO 2	Expertize on scheduling of construction with latest techniques
CO 3	Understand the benefit and productivity of mechanization in construction
CO 4	Know the value of quality and safety in construction
CO 5	Aware of contractual system and enlarged view on legal problems in construction

UNIT – I

Introduction: History of Construction Management, Functions and Responsibilities of Construction Manager, Resources and Advances in Construction Management. Stages and Major problems in Construction Industry.

UNIT – II

New Techniques in construction Management: Work Breakdown of structures, Development of Bar charts, Shortcomings, Remedial measures, Milestone charts. PERT- Elements of

Networks, Development of PERT network, Numbering, Fulkerson's rule, Slack, Identification of Critical Path, Probability of Completion of projects. CPM – Construction of network, Start and Finish times of activities, Floats, Identification of Critical Path using floats.

UNIT – III

Construction Equipment and Management. Equipment Requirements in Construction Industry, Heavy Earth Moving Equipment – Bulldozers, Scrapers, Loaders Shovels and Cranes – Compaction Equipment, Grading Equipment, Aggregate Production Equipment, Hauling Equipment, Concrete Mixing Equipment, Pneumatic Equipment, Bridge Construction Equipment, Drilling and Blasting Equipment, Pumping and Dewatering Equipment.

UNIT – IV

Inspection and Quality Control and safety management. Inspection and Quality Control: Need for Inspection and Quality Control Principles of Inspection – Enforcement of Specifications – Stages of Inspection and Quality Control. Safety Management: Safety importance in construction industry, hazards in construction projects, causes of accidents, cost of an accidents.

UNIT – V

Contracts and Legal issues: Contracts: Execution of Works, Direct execution by Department, Execution through contractor – Definitions – Types of contracts. Legal Issues: Earnest money deposit and Security deposit, Termination of contract. Disputes, Settlement through arbitration,

Indian Arbitration Act 1940, Clauses and advantages of arbitration, Contract Labor Act 1970, Minimum Wages Act 1948, Workmen Compensation Act 1923

Text Books

1. P S Gahlot and B M Dhir "Engineering Construction Planning and Management", New Age International (P) Limited, Publishers, New Delhi.
2. S C Sharma "Construction Equipment and Its Management", Khanna Publishers, New Delhi.

Reference Books

1. M Govindarajan, S Natarajan and V S Senthilkumar "Engineering Ethics", Prentice-Hall of India (P) Limited, New Delhi.
2. Dr. S Seetharaman "Construction Engineering and Management", Umesh Publications, New Delhi.
3. Horpal Singh "Construction Management and Accounts", Tata McGraw-Hill Companies, Inc. New York.

Web Links:

1. https://archive.nptel.ac.in/courses/105/104/105104161/
2. https://archive.nptel.ac.in/courses/105/103/105103093/

Course Title	Finite Element Methods				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092108	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 1.5 Hrs					End Exam Duration : 3Hrs		

Course Objectives:
To understand the concepts of Finite element methods to analyze critical stress conditions in structures.

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

CO 1	Understand the fundamentals of the Finite Element Methods.
CO 2	Derive Finite Element Formulation for one dimensional beam and bar elements.
CO 3	Apply two dimensional elements for analysis of structures.
CO 4	Understand isoperimetric elements and its applications in Finite Element Methods.
CO5	Analyse various structures for static loading conditions using Finite Element Methods.

UNIT - I

Introduction to Finite Element Method- Introduction - Finite Difference Method - Advantages and Disadvantages - Basic Steps – Limitations - Finite Element Modelling and Discretization - Types of Elements - Nodes and Degrees of Freedom - Interpolation and Shape Functions

UNIT – II

One Dimensional & Two-Dimensional Elements- Stiffness matrix for bar element – shape functions for one dimensional element – one dimensional problem. Two Dimensional Elements - Different types of elements for plane stress and plane strain analysis – Displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – Geometric invariance – Natural coordinate system – area and volume coordinates

UNIT - III

Trusses-Plane Trusses - Local and Global Coordinate Systems - Direction Cosines - Element Stiffness Matrix - Assembly of Global Stiffness Matrix - Stress Calculation.

UNIT - IV

Beams- Introduction Beam Stiffness - Assembly of Beam Stiffness Matrix – Loading - Boundary Conditions - Plane Stress - Plane Strain Analysis

UNIT - V

Iso-parametric Elements and Finite Element Modelling- Mesh Requirements - Material Properties - Loads and Reactions - Boundary Conditions - Checking the Model - Analysis and Design Software (For Practice Purpose Only)

Solution Techniques: Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads.

Text Books

1. Daryl L Logan "A First Course in the Finite Element Method", Cengage Learning India Private Limited, New Delhi.
2. S S Bhavikatti "Finite Element Analysis", New Age International (P) Limited, Publishers, New Delhi.

Reference Books

1. Robert D Cook, David S Malkus and Michael E Plesha "Concepts and Applications of Finite Element Analysis", Wiley India Pvt. Limited, New Delhi.
2. George R Buchanan "Theory and Problems of Finite Element Analysis", Tata McGraw-Hill Companies, Inc. New York.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_me43/preview
2. https://archive.nptel.ac.in/courses/112/104/112104193/

Course Title	Environmental Geo-Technology				B. Tech. Honours Degree Course		
Course Code	Hours/Week			Credits	Maximum Marks		
2092109	L	T	P	C	Continuous Internal Assessment	End Exam	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 2 Hrs					End Exam Duration : 3Hrs		

Course Objectives:

- To make the students to learn the concepts of geoenvironmental engineering, planning and design of waste in landfills, ash ponds and tailing ponds.
- To make the students to understand the effects of pollutants on soil properties
- To give awareness about the adverse effects of soil and ground water contaminants
- To analyze and apply various techniques for remediation of the contaminants
- To make the student to understand the reuse of waste materials in geotechnical constructions.

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

CO 1	Understand the synchronization and other distributing resources such as energy storage and fuel cell
CO 2	Understanding of the microgrid types and configurations
CO 3	Applications of power electronics in Micro grid and acquire the knowledge of multifunction grid connected converters
CO 4	Analyze the various types of control in micro grid in islanded and grid connected operation

UNIT – I

Introduction: Industrialization and Urbanization, Pollution, Control, and remediation.

Contamination: Surface contamination, Contamination transport, Soil-a Geotechnical trap, Effect of subsurface contamination, Detection of polluted zone, Monitoring and Effectiveness of designed facilities.

UNIT – II

Contaminants of Solid Waste in Landfills: Waste contaminants, landfills, types, shape, and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills. Landfill construction & operation, sustainable waste management.

UNIT – III

Contaminants of Slurry wastes: Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Design aspects, Environmental Impact, and control.

UNIT – IV

Vertical Barriers for Contaminant: Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls, construction, material, and design aspects.

UNIT – V

Geotechnical Reuse of Waste materials: Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, engineering properties of Wastes, Waste material in Embankment and Fills.

Text Books

1. 1.Lakshmi N. Reddi and Hilary I. Inyang, "Geoenvironmental Engineering: Principles and Applications", CRC Press, United States.
2. Hari D. Sharma and Krishna R. Reddy, "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies", John Wiley and Sons, Inc., United States.

Reference Books

1. 1.David E. Daniel, "Geotechnical Practice for Waste Disposal", Chapman & Hall, Springer Publishers, Germany.
2. Rowe R. Kerry, "Geotechnical and Geoenvironmental Engineering Handbook", Springer Publishers, Germany.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.

Web Links:

1. https://nptel.ac.in/courses/105102160
2. https://archive.nptel.ac.in/courses/105/102/105102160/

<table>
<tr><td>Course Title</td><td colspan="4">Energy Auditing & Demand Side Management</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD201</td><td rowspan="2">Professional Elective Core (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>4</td><td>1</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives: The objective of the course is to learn about energy auditing practices , conservation schemes, different methods to improve power factor, lighting and energy instruments, load and demand side management.</td></tr>
<tr><td colspan="8">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Understand energy auditing practices, energy conservation schemes, energy economics and management</td></tr>
<tr><td>CO 2</td><td colspan="7">Analyze energy conservation measures, energy auditing practices, energy economics and management</td></tr>
<tr><td>CO 3</td><td colspan="7">Design an appropriate energy conservation scheme for commercial and industrial applications</td></tr>
<tr><td>CO 4</td><td colspan="7">Choose appropriate technique for energy auditing and conservation.</td></tr>
</table>

UNIT – I

Energy Auditing: Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, sankey diagrams, load profiles, energy conservation schemes. measurements in energy audits, presentation of energy audit results.

UNIT - II

Energy Efficient Motors: Energy efficient motors, constructional details, loss distribution, factors affecting efficiency, characteristics - variable speed, variable duty cycle systems, RMS HP loading- voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT – III

Power Factor Improvement: Power Factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on pf, pf motor controllers.

UNIT – IV

Lighting and Energy Instruments: Good lighting system design and practice, lighting control ,lighting energy audit - energy instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT – V

Demand Side Management:Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning.

Load Management: Load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. management and organization of energy conservation awareness programs.

Text Books

1. Electrical Power distribution by A. S. Pabla, TMH, 5th edition, 2004.
2. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
3. Energy management hand book by W. C. Turner, John Wiley and Sons.
4. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998.

References

1. Energy efficient electric motors by John. C. Andreas, Marcel Dekker Inc Ltd., 2nd Edition, 1995.
2. Energy management and good lighting practice: Fuel Efficiency- Booklet12 – EEO.
3. Recent Advances in Control and Management of Energy Systems by D. P. Sen, K. R. Padiyar, Indrane Sen, M. A. Pai, Interline Publisher, Bangalore, 1993.
4. Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern, 2005.

<table>
<tr><td>Course Title</td><td colspan="5">Power System Deregulation</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD202</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to learn the basic concept of restructuring of the electricity market, need behind requirement for deregulation of the electricity market and understand the money, power & information flow in a deregulated power system.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various types of regulations in power systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">Identify the need of regulation and deregulation.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the technical and Non-technical issues in Deregulated Power Industry.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify and give examples of existing electricity markets.</td></tr>
<tr><td>CO 5</td><td colspan="8">Classify different market mechanisms and summarize the role of various entities in the market</td></tr>
</table>

UNIT - I

Deregulation of Electric Utilities: Introduction – Traditional central utility model, reform motivations, separation of ownership and operation, competition and direct access in the electricity market, independent system operator (ISO), retail electric providers, different experiences.

UNIT - II

Competitive Wholesale Electricity Markets & Transmission Open Access: Introduction, ISO, wholesale electricity market characteristics, market model, challenges, trading arrangements, the pool and bilateral trades, multi lateral trades.

UNIT - III

Transmission Cost Allocation Methods: Introduction - Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

UNIT - IV

Market Power & Ancillary Services Management: Introduction - Different types of market Power – Mitigation of Market Power – Examples - Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

UNIT - V

Available Transfer Capability (ATC) : Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow - Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

Text Books:

1. Power System Restructuring and Deregulation, Loi Lei Lai, John Wiley & Sons Ltd., England, 2001.
2. Operation of Restructured Power System, Kankar Bhattacharya, Math H.J. Boller and Jaap E. Daalder Kulwer Academic Publishers, 2001.
3. Restructured Electrical Power Systems, Mohammad Shahidehpour and Muwaffaq alomoush, Marcel Dekker, Inc., 2001.

<table>
<tr><td>Course Title</td><td colspan="5">Programmable Logic Controller (PLC) & its Applications</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD203</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives: The main objective of the course is to learn PLC basics, architecture, programming, about digital logic gates, PLC registers, functions and Analog PLC operations and various applications to PLC.</td></tr>
<tr><td colspan="8">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Understand PLC and its basics, architecture, connecting devices and programming</td></tr>
<tr><td>CO 2</td><td colspan="7">Apply Ladder logic for various Industrial Applications</td></tr>
<tr><td>CO 3</td><td colspan="7">Analyze PLC logical and arithmetic operations</td></tr>
<tr><td>CO 4</td><td colspan="7">Design Control Circuits for various Applications</td></tr>
</table>

UNIT - I

PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation.

UNIT - II

Digital Logic Gates: Programming in the Boolean algebra system, conversion examples. Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

UNIT - III

PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

PLC Functions: Timer functions & Industrial applications, counter function & industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT - IV

Data Handling Functions: SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions.

UNIT - V

Analog PLC Operation: Types of PLC Analog Modules and Systems, PLC Analog Signal Processing, BCD or Multibit Data Processing, Analog output application examples, PID Modules, PID Tuning, Typical PID Functions, PLC Installation, Troubleshooting and Maintenance.

Text Books:

1. Programmable Logic Controllers by W. Bolton, 5th Edition, Newnes, Elsevier, 2010.
2. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI.

Reference Books:

1. Programmable Logic Controllers- Programming Method and Applications –JR. Hackworth &F.D Hackworth Jr. –Pearson, 2004.
2. Programmable Logic Controllers: An Emphasis on Design & Application, Kelvin T. Erickson, Dogwood Valley Press, 2011.

<table>
<tr><td>Course Title</td><td colspan="4">Embedded Systems</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD204</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives: The objective of the course is to learn the basic working of a microcontroller system and its programming in assembly language and also to integrate hardware and software for microcontroller applications systems.</td></tr>
<tr><td colspan="8">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Describe the differences between the general computing system and the embedded system, the classification of embedded systems.</td></tr>
<tr><td>CO 2</td><td colspan="7">Illustrate the basic programming models</td></tr>
<tr><td>CO 3</td><td colspan="7">Design real time embedded systems using the concepts of RTOS</td></tr>
<tr><td>CO 4</td><td colspan="7">Apply program modeling and programming with RTOS - 2</td></tr>
</table>

UNIT - I

Introduction: History of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Core of the Embedded System, Sensors and Actuators, Communication Interface, Embedded Firmware.

Hardware Software Co-Design and Programme Modelling: Characteristics of an Embedded System, Quality Attributes of Embedded Systems, Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (UML),Hardware Software Trade-offs.

UNIT - II

Real-Time Operating Systems (RTOS) Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling :Putting them Altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS.

UNIT - III

Devices and Communication Buses for Devices Network: IO Types and Examples, Serial Communication Devices, Parallel Device Ports, Sophisticated Interfacing Features in Device Ports, Wireless Devices, Timer and Counting Devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Serial Bus Communication Protocols, Parallel Bus Device Protocols- Parallel Communication Network Using ISA, PCI, PCI-X and Advanced Buses, Internet Enabled Systems- Network Protocols, Wireless and Mobile System Protocols.

UNIT - IV

Real Time Operating Systems: Process Management, Memory Management, Device, File and IO Subsystems Management, Interrupt Routines in RTOS Environment and Handling of Interrupt Source Calls, Real-time Operating Systems, Basic-Design an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Matrices, OS Security Issues.

UNIT - V

Design Examples and Case Studies of Program Modeling and Programming With RTOS-2: Case study of Communication between Orchestra Robots, Embedded Systems in Automobile, Case study of an Embedded System for Adaptive Cruise Control(ACC) System in a Car, Case study of an Embedded System for a Smart Card, Case study of a Mobile Phone Software for Key Inputs.

Text Books

1. Introduction to Embedded System- Shibu KV, Mc-Graw Hill Higher Edition.
2. Embedded Systems Architecture, Programming and Design- Raj Kamal, Second Edition, McGraw-Hill Companies.
3. Embedded System Design by Peter Marwedel, Springer.

Reference Books

1. Embedded System Design – A Unified Hardware/Software Introduction-Frank Vahid, Tony D. Givargis, John Wiley, 2002.
2. Embedded/ Real Time Systems-KVKK Prasad, Dreamtech Press, 2005.
3. An Embedded Software Primer- David E. Simon, Pearson Ed. 2005.

<table>
<tr><td>Course Title</td><td colspan="5">Electric & Hybrid Vehicles</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD205</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to learn upcoming technology of hybrid systems, different aspects of drives application & electric traction.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand electric drive in vehicles / traction</td></tr>
<tr><td>CO 2</td><td colspan="8">Acquire knowledge about fundamental concepts, principles of hybrid and electric vehicles</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze and design of hybrid and electric vehicles</td></tr>
</table>

UNIT - I

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics and mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT - II

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT - III

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of

Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switched Reluctance Motor drives, drive system efficiency.

UNIT - IV

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT - V

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books

1. Hybrid Electric Vehicles: Principles and applications with Practical Perspectives by C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
2. Hybrid Electric Vehicles: Energy Management Strategies by S. Onori, L. Serrao and G. Rizzoni, Springer, 2015.

Reference Books

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design by Ehsani, Gao, Gay, Emadi, 2005 by CRC Press.
2. Electric and Hybrid Vehicles by T. Denton, Routledge, 2016.

<table>
<tr><td>Course Title</td><td colspan="5">Smart Grid</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD206</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives: The student is able to learn fundamentals, Architecture and analysis of smart grid with communication, networking and measuring technologies involved in it.</td></tr>
<tr><td colspan="8">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Understand the features, fundamental components and architecture of smart grid</td></tr>
<tr><td>CO 2</td><td colspan="7">Explain information, communication and networking technologies involved with the smart grid</td></tr>
<tr><td>CO 3</td><td colspan="7">Explain operation and importance of PMU, WAMPS and smart storage systems in smart grid</td></tr>
<tr><td>CO 4</td><td colspan="7">Analyze Micro grid with various concepts and challenges in future</td></tr>
</table>

UNIT - 1

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Need of Smart Grid – Smart Grid Functions – Opportunities & Barriers of Smart Grid - Conventional Power Grid and Smart Grid -Concept of Resilient & Self-Healing Grid.

UNIT - II

Smart Grid Architecture: Components and Architecture of Smart Grid – Review of Proposed Architectures for Smart Grid – The Fundamental Component of Smart Grid Designs – Transmission Automation – Distribution Automation –Renewable Integration.

UNIT - III

Information and Communication Technology: Smart sensors, Wired and wireless communication Technology, Network Structures (HAN, LAN, NAN, WAN), Introduction to Smart Meters – Advanced Metering Infrastructure (AMI).

UNIT - IV

Smart Grid Technologies: Geographic Information System (GIS) - Intelligent Electronic Devices (IED) - Smart storage like Battery- SMES - Pumped Hydro - Compressed Air Energy Storage - Wide Area Measurement System (WAMS) – SCADA - Phasor Measurement Unit (PMU).

UNIT – V

Micro grids and Distributed Energy Resources: Concept of micro grid, need & application of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid, Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, and fuel cells.

Text Books

1. Janaka Ekanayake, Kithsir iLiyanage, Jian zhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
2. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 1e,2013.
3. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"- Wiley, IEEE Press, 2012.

Reference Books

1. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
2. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
3. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.

<table>
<tr><td>Course Title</td><td colspan="5">Industrial Automation & Control</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD207</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The student is able to learn Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn the basics of automation, how systems work and the importance of PLC, SCADA and robots in automation. This course will provide an opportunity to learn industrial automation techniques.</td></tr>
<tr><td colspan="9">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various automation components and systems</td></tr>
<tr><td>CO 2</td><td colspan="8">Draw block diagram of industrial automation and control system</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain architecture of industrial automation system</td></tr>
<tr><td>CO 4</td><td colspan="8">Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.</td></tr>
</table>

UNIT – I

Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & Profibus

UNIT - II

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT – III

Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and

networking, Industrial communication systems, Data transfer techniques, Computer aided process control software and Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT –IV

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT – V

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text Books

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, Jaico Publishing House, 2013
4. Programmable logic controller, Dunning, Delmar

Reference Books

1. Groover, Mikell. P: Automation, Production systems and Computer integrated Manufacturing –Prentice hall India-2004.
2. Mark W Spong& M Vidyasagar: Robot Dynamics and Control, John Wiley & Sons, 1989
3. Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Printice Hall of India 1996
4. R.K.Mittal and I.J. Nagarath: Robotics and Control, TMH-2003.

<table>
<tr><td>Course Title</td><td colspan="5">SCADA & Its Applications</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD208</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The student is able to understand SCADA and its applications.</td></tr>
<tr><td colspan="9">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.</td></tr>
<tr><td>CO 2</td><td colspan="8">Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system</td></tr>
<tr><td>CO 3</td><td colspan="8">Acquire knowledge about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server</td></tr>
<tr><td>CO 4</td><td colspan="8">Acquire knowledge about SCADA communication, various industrial communication technologies, open standard communication protocols</td></tr>
<tr><td>CO5</td><td colspan="8">Learn and understand about SCADA applications in transmission and distribution sector, industries etc</td></tr>
<tr><td>CO6</td><td colspan="8">Gain knowledge and understanding for the design and implementation of a SCADA system</td></tr>
</table>

UNIT - I

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries

UNIT - II

SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT - III

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850

UNIT - IV

SCADA Communication: Various industrial communication technologies -wired and wireless methods and fiber optics. Open standard communication protocols

UNIT - V

SCADA Applications: Utility applications- Transmission and Distribution sector - operations, monitoring, analysis and improvement. Industries - oil, gas and water.

Text Books

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA,2004.
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004.

Reference Books

1. William T. Shaw, Cyber security for SCADA systems, PennWell Books, 2006.
2. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003.
3. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric power, PennWell 1999.

<table>
<tr><td>Course Title</td><td colspan="4">Distributed Generation & Micro Grid</td><td colspan="3">B. Tech.
Honours Degree Course</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20HD209</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="8">Course Objectives: The student is able to learn about different distributed generations, energy storage devices and Micro grid systems and Understanding the concepts of system development and relevant issues.</td></tr>
<tr><td colspan="8">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="7">Understand the synchronization and other distributing resources such as energy storage and fuel cell</td></tr>
<tr><td>CO 2</td><td colspan="7">Understanding of the microgrid types and configurations</td></tr>
<tr><td>CO 3</td><td colspan="7">Applications of power electronics in Micro grid and acquire the knowledge of multifunction grid connected converters</td></tr>
<tr><td>CO 4</td><td colspan="7">Analyze the various types of control in micro grid in islanded and grid connected operation</td></tr>
</table>

UNIT - I

Introduction to Distributed Generation: DG Units - Micro turbines, reciprocating engines, wind generators, photovoltaic generators, fuel cells, biomass, and tidal sources - Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Sitting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT - II

Grid integration of DGs: Synchronization - Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Distributed resources to electric power systems: IEEE 1547. Energy storage elements: Batteries, ultra-capacitors, flywheels.

UNIT - III

Economics and Regulatory Aspects of DGs: Selection of sources, regulatory standards/ framework, Standards for interconnecting DG installation classes, security issues in DG implementations. Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs.

UNIT - IV

Introduction to Micro grid: Micro grid Configurations – CERTS Micro grid Test Bed – DC Micro grid- HFAC Micro grid –LFAC – Micro grid – Hybrid DC- and AC- Coupled Micro grid.

Power Electronics in Micro grid: Power Electronics based Microgrid - Grid Connected Mode – Islanded mode – Battery Charging mode – design of parallel inverters – Microgrid application - Brick Busses Software Framework.

UNIT - V

Control in Micro grid: Impact of load characteristics – Local control – Centralized Control- Decentralized Control Microgrid control for island operation – PQ Control - Droop control methods – Frequency/Voltage Control – Control of Inverter Output Impedance.

Text Books

1. N. Jenkins, J.B. Ekanayake and G. Strbac, 'Distributed Generation', IET Press, 2010.
2. Nikos Hatziargyiou, "Micro grids: Architectures and Control", Wiley-IEEE Press, December 2013.

Reference Books

1. Suleiman M. Sharkh, Mohammad A. Abu-Sara, Georgios I. Orfanoudakis, Babar Hussai, "Power Electronic Converters for Microgrid" , Wiley-IEEE Press, 2014.
2. S. Chowdhury, S. P. Chowdury and Peter Crossley," Microgrids and Active Distribution Networks" ISBN978-1-84919-014-5, IET renewable Energy series, 2009.

Course Title	Alternative Fuels and Emission Control in Auto motives				B.Tech ME (HONOURS)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20HN301	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**		

Course Objectives:

. The students completing this course are expected:

- Explain various alcohol and gaseous fuels and their use in SI and CI engines.
- Explain various vegetable oils and their use in CI engines.
- Determine the formation of various emissions from SI engine and control techniques.
- Identify various emission measuring instruments and test procedures.

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

CO 1	Identify various emissions from SI and CI engines.
CO 2	Apply the properties of alcohol fuels and gaseous fuels.
CO 3	Predict the problems by using vegetable oils in diesel engines.
CO 4	Choose the use of various emission measuring instruments.
CO 5	Identify various emissions from SI and CI engines.

UNIT - I

Alcohol fuels and gaseous fuels: Alcohol fuels and gaseous fuels: Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system, Spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in SI and CI engines, Properties of hydrogen, production and storage methods, safety precautions, biogas production and its properties, properties of LPG and CNG, Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines

UNIT - II

Vegetable oils: Vegetable oils: Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, Methods to improve the engine performance using vegetable oils – preheating, Esterification , blending with good secondary fuels, Semi-adiabatic engine, surface ignition engine, ignition accelerators dual

fuelling with gaseous and liquid fuels coils, Performance, combustion and emission characteristics of biodiesel fuelled diesel engines

UNIT - III

Emissions from SI engines and their control Emissions from SI engines and their control: Emission formation in SI engines (CO, HC and NOx), Effect of design and operating variables on emission formation, Control techniques – Thermal reactor, exhaust gas recirculation, Three way catalytic convertor and Charcoal canister control for evaporative emission, Positive crank case ventilation for blow by gas control.

UNIT - IV

Emissions from CI engines and their control:

Emissions from CI engines and their control: Emission formation in CI engines (HC, CO, NOx, Aldehydes, smoke and particulates), Effect of design and operating variables on emission formation, Control techniques – Exhaust gas recirculation, NOx selective catalytic reduction, Diesel oxidation catalytic convertor, Diesel particulate filter, NOx versus particulates – Trade off.

UNIT - V

Emission measuring instruments and test procedures Emission measuring instruments and test procedures: Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO2 and CO by NDIR, Hydrocarbon emission by FID, Chemiluminescentanalyser for NOx, Liquid and Gas chromatograph Spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms.

Text Books:

1. Ganesan V, Internal combustion engines, 4th Edition, Tata McGraw Hill Education, 2012
2. Thipse.S.S, Alternative Fuels: Concepts, Technologies and Developments, Jaico Publishing House, 2010.

Reference Books:

1. Michael F. Hordeski, Alternative Fuels: The Future of Hydrogen, The Fairmont Press, 2008
2. R.K.Rajput, A textbook of Internal Combustion Engines, 2nd Edition, Laxmi Publications, 2007
3. “Society of Automotive Engineers”, Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000

Course Title	Automation And Robotics					B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN302	PEC-I	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

The objectives of this course are to

- Describe the basic concepts of automation in manufacturing systems
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.
- Define the fundamental concepts of industrial robotics.
- Apply basic mathematics to calculate the robot kinematic and dynamic mechanics
- Understand the robot programming methods and software packages.

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

CO 1	Examine the types of hardware components of automation and control
CO 2	Design a simple material handling system for low cost manufacturing.
CO 3	Design a simple gripper for robot.
CO 4	Compare the types of actuators used in robot manipulator
CO 5	Summarize the requirements and features of robot programming

UNIT – I

Introduction: Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices. Automated flow lines & transfer mechanisms, fundamentals of transfer Lines, flow lines with or without buffer storage.

UNIT - II

Assembly Line Balancing and Automated Manufacturing System Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines. Material handling and Identification Technologies: Overview of automatic material handling systems, principles and design consideration,

material transport systems, storage systems, overview of automatic identification methods. Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

UNIT - III

Introduction to Robotics Introduction: Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers. Robot Actuators And Feedback Components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT - IV

Kinematics and Dynamics of a Manipulator Manipulator Kinematics Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations.

UNIT – V

Robot Programming and Applications Robot Programming: Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control- slew motion, joint integrated motion, straight line motion; avoidance of obstacles. Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading; Process - spot and continuous arc welding & spray painting; Assembly and Inspection

Textbooks:

1. MikellP.Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education.5/e, 2009.
2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G.Odrey , Industrial Robotics — McGraw Hill, 1986.

Reference Books:

1. S. R. Deb &Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education. 2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
2. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
3. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

Course Title	Tool Design				B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20HN303	PEC-I	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

The objectives of this course are to

- Design Tools that can withstand all forces acting on them.
- Design tools which reduce downtime and hence increase production.
- Select the tool material that increases the tool life.
- Provide simple and smooth, easy operation machine tools to maximize the efficiency.
- To produce the components of high quality that required fewer secondary operations on them.

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

CO 1	Determine the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting.
CO 2	Identify basic parts and operations of machine tools including lathe, shaper, planer, drilling, boring, milling and grinding machine.
CO 3	Design locating and clamping devices to produce a component.
CO 4	Select a machining operation and corresponding machine tool for a specific application in real time
CO 5	Select a measuring instrument to inspect the dimensional and geometric features of a given component

UNIT – I

Introduction to Tool Design

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings - Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT - II

Design of Cutting Tools

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT - III

Design of Jigs and Fixtures

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

UNIT - IV

Design of Press Tool Dies

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies- Design and drafting.

UNIT - V

Tool Design for CNC Machine Tools

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Text Books:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman,” Jig and Fixture Design”, Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1. PrakashHiralal Joshi, “Tooling data”, Wheeler Publishing, 2000 .
2. Venkataraman K., “Design of Jigs, Fixtures and Presstools”, TMH, 2005.
3. Haslehurst M., “Manufacturing Technology”, The ELBS, 1978.
4. Online Learning Resources

Course Title	Power Plant Engineering					B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN304	HN	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

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

CO 1	Outline sources of energy, power plant economics, and environmental aspects.
CO 2	Describe working of a steam power plant and their components
CO 3	Illustrate the working mechanism of Diesel and Gas turbine power plants.
CO 4	Understand the various elements of hydroelectric power plant and their types
CO 5	Summarize types of renewable energy sources and their working principle.

UNIT- I

Introduction to the Sources Of Energy - Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection.

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises.

UNIT –II

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant: Construction- Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.

UNIT –III

Diesel Power Plant: Diesel Power Plant: Introduction - IC Engines, Types, Construction- Plant Layout with Auxiliaries - Fuel Storage

GAS Turbine Plant: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And

Disadvantages Combined Cycle Power Plants.

UNIT- IV

Hydro Electric Power Plant: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

Hydro Projects & Plant: Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

UNIT- V

Power From Non-Conventional Sources: Utilization of Solar Collectors- Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

Text books:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, DhanpatRai& Co (P) Ltd, 2014

Reference Books:

1. Rajput, A Text Book of Power Plant Engineering, 6/e, Laxmi Publications, 2020.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2019
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2019.

Course Title	NON-DESTRUCTIVE TESTING				B. Tech. ME(HONOURS)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20HN305	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Introduce basic concepts of non destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- Impart NDE and its applications in pressure vessels, casting and welded constructions.

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

CO 1	**Predict** various methods of non-destructive testing.
CO 2	**Apply** relevant non-destructive testing method different applications.
CO 3	**Explain** the applications of Railways, Nuclear and chemical industries.
CO 4	**Outline** the limitations and disadvantages of NDE.
CO5	**Explain** the applications of NDA of pressure vessels, casting and welding constructions

UNIT - I

Introduction to non-destructive testing: Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT – II

Ultrasonic test Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III

Liquid penetrant, Eddy Current & Magnetic Particle Test: Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.
Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT – IV

Infrared & Thermal Testing Infrared And Thermal Testing

Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

UNIT - V

Industrial Applications of NDE

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Text Books:

1. J Prasad, GCK Nair , Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

Reference Books:

1. Gary L. Workman, Patrick O. Moore, DoronKishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.

Course Title	Ergonomics and Human Factors in Engineering				B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN306	PEC-I	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- Manmachine-environment interaction system and user-friendly design practice;
- Human compatibility, comfort and adaptability; Fundamentals of ergonomics:Physical (anthropometrics, human body- structure and function, posture, movement and biomechanics),
- Physiological (work physiology) and Psychological aspects (behavior, cognitive aspects and mental workload);
- Information processing, human error and risk perception;Visual performance and visual displays; environmental factors influencing human performance;
- Occupational stress; safety and health issues;Ergonomics criteria/check while designing; Design process involving ergonomics check and ergonomic design evaluation and Participatory ergonomics aspects.

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

CO 1	Determine Mutual task comfort
CO 2	Identify basic Posture and job relation Posture and body supportive devices
CO 3	Design Module Visual Issues Visual performance Visual displays
CO 4	Select Ergonomics design methodology Ergonomics criteria in real time
CO 5	Design and human compatibility, comfort and adaptability aspects

UNIT –I

Introducing Ergonomics, Welcome and content details, Design today- Human aid to lifestyle, Discipline approach: Ergonomics/ Human factors, Journey, Fitting task to man their contractual structure Domain, Philosophy and Objective Mutual task comfort: two way dialogue, communication model Ergonomics/ human Factors fundamentals Physiology (work physiology) and stress

UNIT –II

Human physical dimension concern Human body- structure and function, anthropometrics Anthropometry: body growth and somatotypes Static and dynamic anthropometry,Stand Posture- erect Anthropometry landmark:Sitting postures Anthropometry: squatting and cross-legged postures Anthropometric measuring techniques Statistical treatment of data and percentile calculations Module Posture and movement Human body- structure and function Posture and job relation Posture and body supportive devices Chair characteristics Vertical work surface Horizontal work surface Movement Work Counter

UNIT –III

Behavior and perception Communication and cognitive issues Psycho-social behavior aspects, behavior and stereotype Information processing and perception Cognitive aspects and mental workload Human error and risk perception Module Visual Issues Visual performance Visual displays

UNIT -IV

Environments Factors , Environmental factors influencing human performance Ergonomic design process Ergonomics design methodology Ergonomics criteria/check while designing Design process involving ergonomics check Some checklists for task easiness

UNIT –V

Performance support and design intervention Occupational safety and stress at workplace in view to reduce the potential fatigue, errors, discomforts and unsafe acts Workstation design Furniture support Vertical arm reach and design application possibility Humanizing design: Design and human compatibility, comfort and adaptability aspects Design Ergonomics in India: scope for exploration Concluding session: Design Ergonomics in India: scope for exploration

Text Books:

1. Bridger, RS: Introduction to Ergonomics, 2nd Edition, Taylor &Francis, 2003.
2. Dul, J. and Weerdmeester,B.Ergonomics for beginners, a quick reference guide, Taylor & Francis, 1993.

Reference Books:

1. Green, W.S. and Jordan,P .W, Human Factors in Product Design, Taylor & rancis, 1999.
2. D. Chakrabarti, Indian Anthropometric Dimensions for ergonomic design practice, National Institute of Design,Ahmedabad, 1997
3. G.Salvendy (edit), Handbook of Human Factors and ergonomics, John Wiley & Sons, Inc., 1998
4. Singh,S (Edt),Ergonomics Interventions for Health and Productivity, Himanshu Publications, Udaipur, New Delhi, 2007

Course Title	Dynamics of Machinery					B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN307	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- To introduce the laws of precession.
- To learn about the working of different types of brakes and dynamometers,
- To able to design the fly wheel for an IC engine,
- To introduce different types of Governors,
- To analyze the unbalanced forces acting in rotating and reciprocating system and to know the balancing methods of different mechanical systems..

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

CO 1	Solve the numerical problems on brakes and understand the working of Dynamometers
CO 2	Apply gyroscopic principles on aero planes, ships, four wheel and two wheel vehicles.
CO 3	Analyze the basics of Governors and forces acting on various governors.
CO 4	Evaluate the numerical problems on Balancing of Rotating masses and reciprocating masses.
CO 5	Design the response of single degree freedom systems with free and forced vibration, and can Evaluate the critical speed of the shaft.

UNIT -I

Balancing: Balancing of rotating masses- single and multiple masses- single and different planes Balancing of Reciprocating masses- Primary and secondary balancing of reciprocating masses-graphical methods. Unbalanced forces and couples-V-engine, multi cylinder in line and radial engine for primary and secondary balancing.

UNIT-II

Turning Moment Diagrams and Flywheels: Turning moment diagrams for IC engine and multi cylinder engine. Crank effort- coefficient of fluctuation of energy, coefficient of fluctuation of speed-Fly wheels and their design, fly wheels for punching machines.

UNIT -III

Governors: Watt, Porter and Proell governors. Spring loaded governors- Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting.Effort and power of agovernor.

UNIT -IV

Brakes and Dynamometers: Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers- absorption and transmission types. General description and methods of operation.

Precession: Gyroscopes, effects of precession motion on the stability of moving vehicles such as motor car, motorcycle, aero planes

UNIT-V

Vibration: Free and forced vibration of single degree of freedom system, Role of damping, Whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibrationisolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly'smethod. Torsional vibrations-two and three rotor systems.

Text Books:

1. Thoery of Machines, S.S Ratan, MGH
2. Theory of machines, Khurmi, S.Chand.
3. Kinematics and Dynamics of machinery-R.L.NORTON,TATA MC GRAW HILL
4. Theory of machines- J.E.SHIEGLEY, MC GRAW HILL

Reference Books:

1. Theory of machines,THOMOS BEVAN, PEARSON PUBL, 3RD EDITION
2. Mechanism and mechanics :Mchal.M.StanisicCengageindia publishers 1st edition
3. Theory of Machines and Mechanism ,JOHN VICKY J.VR,GORDON R.PENNOK JOSEPH 5TH EDITION OXFORD PUBLICATION
4. Design of machine elments , M.F.SPOTS ,TE,SOUP 8TH EDITION PEARSON

Course Title	Solar And Wind Energy Systems				B.Tech ME (HONOURS)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN308	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

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

CO 1	Determine the basic concepts of solar radiation and solar collectors .
CO 2	Design the solar photo voltaic systems for different applications.
CO 3	Identify wind energy as alternative form of energy and to know how it can be tapped.
CO 4	Use the application of wind energy and wind energy conversion systems.
CO 5	Utilize different wind parameters for design of rotors.

UNIT - I

Solar radiation and collectors: Solar radiation and collectors: Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods- evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

Solar thermal technologies: Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT - II

Solar PV fundamentals: Solar PV fundamentals: Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaics.

SPV system design and applications: Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - standalone -

hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - III

Introduction to wind energy: Introduction: Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations.

Basics of Wind Resource Assessment: Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation.

UNIT - IV

Wind Energy Conversion Systems: Wind Energy Conversion Systems: Types - Components of Modern Wind Turbine (HAWT and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

UNIT - V

Wind Farm Design and Health (Condition) Monitoring: Wind Farm Design and Health (Condition) Monitoring: Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts.

Small Wind Turbines: Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

Text Books:

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2. Chetan Singh Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.
3. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).

Reference Books:

1. Sukhatme S.P..Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
3. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).

4. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010.
5. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.
6. R. Jha, Wind Turbine Technology, CRC Press, (2010).

Course Title	COMPUTATIONAL FLUID DYNAMICS				B. Tech. ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20HN309	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Teach the basics of the major theories, approaches and methodologies used in CFD.
- Familiar with the differential equations for flow phenomena and numerical methods for their solutions.
- Introduce explicit and implicit schemes in hyperbolic equations.
- Expose the students to solve the problems through finite volume method.
- Understand the concepts of linear fluid flow problems, steady state problems and transient problems.

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

CO 1	**Examine** the major theories, approaches and methodologies used in CFD.
CO 2	**Formulate** finite volume method for two and three dimensional fluid flow problems.
CO 3	**Apply** numerical models to fluid flow and heat transfer calculations.
CO 4	**Demonstrate** the ability to communicate the results of this detailed fluid-flow study in a written format.
CO5	**Outline** the ability to describe various flow features in terms of appropriate fluid mechanical principles and force balances.

UNIT - I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

Formulations of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

Finite Volume Method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – V

Standard Variational Methods: Linear fluid flow problems, steady state problems, Transient problems.

Text Books:

1. Computational fluid dynamics/ T. J. C'hung/ Cambridge University press,2002.
2. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ McGraw Hill.

Reference Books:

1. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985.
2. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hemashava Publishers corporation&McGraw Hill.
3. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications.
4. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
5. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis / Oxford.

Course Title	Six Sigma and Lean Manufacturing				B.Tech ME (HONOURS)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN310		L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Introduce the students, the basic concepts of six sigma and lean manufacturing.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of cellular manufacturing and 5S.

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

CO 1	Demonstrate various techniques that are related to the six-sigma and lean manufacturing.
CO 2	Outline the concepts of cellular manufacturing, JIT and TPM.
CO 3	Illustrate the principles and implementation of 5S techniques.
CO 4	Select procedure and principles of value stream mapping.
CO 5	Determine the reliability function using six-sigma.

UNIT - I

Introduction to Six-Sigma: Introduction to Six-Sigma-Probabilistic models-Six Sigma measures-Yield-DPMO-Quality level-Reliability function using Six-Sigma-MTTF using Six Sigma-Maintenance free operating period- Availability using Six-Sigma-Point availability-Achieved availability-Operational Availability-Examples

UNIT - II

The Elements of Six Sigma and their Determination: The Elements of Six Sigma and their Determination-The Quality Measurement Techniques: SQC, Six Sigma, Cp and Cpk-The Statistical quality control (SQC) methods-The relationship of control charts and six sigma-The process capability index (Cp)-Six sigma approach-Six sigma and the 1.5 σ shift-The Cpk Approach Versus Six Sigma-Cpk and process average shift- Negative Cpk-Choosing six sigma or Cpk-Setting the process capability index-Examples.

UNIT - III

Introduction To Lean Manufacturing: Introduction To Lean Manufacturing: Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT - IV

Cellular Manufacturing, JIT, TPM: Cellular Manufacturing, JIT, TPM :Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT –

Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT - V

Set Up Time Reduction, TQM, 5S, VSM 10,Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

Textbooks:

1. U Dinesh Kumar, Crocker, Chitra and HaritheSaranga, Reliability and Six Sigma, Springer Publishers.
2. Sung H. Park, Six Sigma for Quality and Productivity Promotion, Asian Productivity Organization
3. Rother M. and Shook J, 1999 _Learning to See: Value Stream Mapping to Add Value
   and Eliminate Muda‘ , Lean Enterprise Institute, Brookline, MA.

Reference Books:

1. Sammy G. Shina, Six Sigma for Electronics Design and Manufacturing, McGraw-Hill.
2. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B. Goldberg, John Wiley & Sons, 2003.
3. Mikell P. Groover (2002) _Automation, Production Systems and CIM.

Course Title	Energy Auditing					B.Tech ME (HONOURS)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20HN311	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Introduce the concepts of energy scenario and need for energy policy for industries in India.
- Familiarize with the Energy Audit concepts and its approaches.
- Teach the principles and objectives of the Energy management.
- Discuss the Thermal and Electrical Energy management

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

CO 1	Summarize the fundamental aspects of energy scenario in India.
CO 2	Analyze the various national and state level energy policy.
CO 3	Develop the concepts of energy conservation in boilers.
CO 4	Select the thermal energy components.
CO 5	Illustrate the concepts of supply methods to minimize supply.

UNIT - I

General Aspects: Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportUNITies, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies.

UNIT - II

Energy Audit Concepts: Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

UNIT - III

Principles and Objectives of Energy Management: Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of

Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

UNIT - IV

Thermal Energy Management: Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps –HVC industries-Building Energy Management.

UNIT - V

Electrical Energy Management: Supply side Methods to minimize supply-demand gap-Renovation and modernization of power plants - Reactive power management – HVDC-FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors.

Text Books:

1. Murphy, W. R., Energy Management, Elsevier, 2007.
2. Smith, C. B., Energy Management Principles, Pergamum, 2007
3. Handbook of Energy Audit, Sonal Desai, Mcgraw Hill Education Private Ltd.,

Reference Books:

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley a. Interscience publication)
4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

Course Title	Scientific Computing using MATLAB					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092401	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives:

- To understand various command in MATLAB and to Solve algebraic equations using MATLAB.
- To Write the programs for curve fitting, roots of equations, Numerical Differentiation and integration.

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

CO 1	Understand various commands in MATLAB
CO 2	Solve algebraic equations using MATLAB
CO 3	Write the programs for curve fitting and roots of equations.
CO 4	Write the programs for Numerical Differentiation and integration.
CO 5	Solve optimization and Eigen value problems.

UNIT- I

Introduction to MATLAB: Introduction to MATLAB, Data Types and Variables, Arrays, Cells, Strings, Operators, Flow Control, Loops, Functions, Input/Output, Array Manipulation, Plotting.

Systems of Linear Algebraic Equations: Introduction, Gauss Elimination Method, LU Decomposition Methods, Symmetric and Banded Coefficient Matrices, Pivoting, Matrix Inversion, Iterative Methods-Gauss–Seidel Method, Conjugate Gradient Method.

UNIT -II

Interpolation and Curve Fitting: Introduction, Polynomial Interpolation-Lagrange's Method, Newton's Method, Neville's Method, Limitations of Polynomial Interpolation, Interpolation with Cubic Spline, Least-Squares Fit.

Roots of Equations: Introduction, Incremental Search Method, Method of Bisection, Brent's Method, Newton–Raphson Method, Systems of Equations, Zeros of Polynomials.

UNIT- III

Numerical Differentiation: Introduction, Finite Difference Approximations, Richardson Extrapolation, Derivatives by Interpolation.

Numerical Integration: Introduction, Newton–Cotes Formulas, Romberg Integration, Gaussian Integration, Multiple Integrals.

UNIT -IV

Initial Value Problems: Introduction, Taylor Series Method, Runge–Kutta Methods, Stability and Stiffness, Adaptive Runge–Kutta Method, Bulirsch–Stoer Method.

Two-Point Boundary Value Problems: Introduction, Shooting Method, Finite Difference Method.

UNIT -V

Symmetric Matrix Eigenvalue Problems: Introduction, Jacobi Method, Inverse Power and Power Methods, Householder Reduction to Tridiagonal Form, Eigenvalues of Symmetric Tridiagonal Matrices.

Introduction to Optimization : Introduction, Minimization Along a Line, Conjugate Gradient Methods.

Text Books:

1. JaanKiusalaas, "NUMERICAL METHODS IN ENGINEERING WITH MATLAB", Cambridge university press, 2005.
2. Stephen J. Chapman, "MATLAB Programming for Engineers", Thomson learning, 4th edition.

Reference Books:

1. Ian Gladwell, Warren Ferguson Jr., James G. Nagy, "Introduction to Scientific Computing Using MATLAB", Lulu Publishing, 2011.
2. AlfioQuarteroni,FaustoSaleri, Paola Gervasio, "Scientific Computing with MATLAB and Octave", Springer International Publishing, 4 th edition, 2014.

NPTEL Link:

1. https://onlinecourses.nptel.ac.in/noc20_ma40/preview
2. https://nptel.ac.in/courses/111/102/111102137/

Course Title	Computer System Architecture				Honours Degree			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2092402	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives

- To Understand different parallel computer models
- To Describe the advanced processor technologies
- To Interpret memory hierarchy and mechanisms for enforcing cache coherence
- To Compare different multiprocessor system interconnecting mechanisms
- To Analyze different pipelining techniques

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

CO 1	Understand different parallel computer models.
CO 2	Describe the advanced processor technologies
CO 3	Interpret memory hierarchy and mechanisms for enforcing cache coherence
CO 4	Compare different multiprocessor system interconnecting mechanisms
CO 5	Analyze different pipelining techniques

Unit- I

Introduction: Parallel computer models – Evolution of Computer Architecture, System Attributes to performance, Amdahl's law for a fixed workload. Multiprocessors and Multicomputers, Multivector and SIMD computers, Architectural development tracks, Conditions of parallelism.

Unit- II

Processors and memory hierarchy: Advanced processor technology- Design Space of processors, Instruction Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar and vector processors, Memory hierarchy technology.

Unit- III

Multiprocessors system interconnects: Hierarchical bus systems, Cross bar switch and multi-port memory, Multistage and combining networks. Cache Coherence and Synchronization Mechanisms, Cache Coherence Problem, Snoopy Bus Protocol, Directory Based Protocol, Hardware Synchronization Problem

Unit-IV

Message Passing Mechanisms: Message Routing schemes, Flow control Strategies, Multicast Routing Algorithms. Pipelining and Superscalar techniques – Linear Pipeline processors and Nonlinear pipeline processors

Unit-V

Instruction pipeline design: Arithmetic pipeline deign -Super Scalar Pipeline Design. Multithreaded and data flow architectures - Latency hiding techniques, Principles of multithreading - Multithreading Issues and Solutions, Multiple context Processors, Fine-grain Multicomputer- Fine-grain Parallelism. Dataflow and hybrid architecture

Text Book:

1. K. Hwang and NareshJotwani, Advanced Computer Architecture, Parallelism, Scalability, Programmability, TMH, 2010.

References Books:

1. H P Hayes, "Computer Architecture and Organization", McGraw Hill, 1978.
2. K. Hwang &Briggs , "Computer Architecture and Parallel Processing", McGraw Hill International, 1986
3. M J Flynn, "Computer Architecture: Pipelined and Parallel Processor Design", Narosa Publishing House, 2012.
4. M Sasikumar, D Shikkare and P Raviprakash, "Introduction to Parallel Processing", PHI, 2014.
5. P M Kogge, "The Architecture of Pipelined Computer", McGraw Hill, 1981.
6. P V S Rao , Computer System Architecture, PHI, 2009.
7. Patterson D. A. and Hennessy J. L., Morgan Kaufmann , „Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann Pub, 4/e, 2010.

Course Title	Electromagnetic Interference & Compatibility				Honours Degree			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092403	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To Understand the effect of EM noise in system environment and its sources.
- To Identifying of EMI hotspot and various techniques like Grounding, Filtering, Soldering, etc
- To Understanding the various aspects of shielding.
- To Designing electronic systems that function without errors or problems related to electromagnetic compatibility

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

CO 1	Understand the effect of EM noise in system environment and its sources.
CO 2	Identifying of EMI hotspot and various techniques like Grounding, Filtering, Soldering, etc.
CO 3	Understanding the various aspects of shielding.
CO 4	Designing electronic systems that function without errors or problems related to electromagnetic compatibility

UNIT - I

Introduction to EMC: Definition, Sources, units, Electromagnetic principles-Faraday's and Ampere's equations, Gauss's equation, boundary conditions,Uniform plane wave, Transmission lines,Dipoles. High-frequency behavior of components-Conductors, Capacitors, inductors, resistors, mechanical switches and transformers.

UNIT - II

Crosstalk or near-field coupling: Capacitive coupling, inductive coupling, common-impedance coupling, Crosstalk combinations, Coupling to shielded cables, Electromagnetic coupling in the far-field, field coupling.

UNIT - III

EM topology & grounding and Shielding: Solutions to EMC problems - Lay out and control of interfaces, Grounding or earthing, Electromagnetic Shielding. Shielded cables Filters and Surge protectors.

UNIT - IV

Solutions to EMC problems: Shielded cables Filters and Surge protectors,Lightning Protection- Currents, charges and fields, Buildings, Towers, Lightning safety.

UNIT - V

EMC measurements and Standards: Testing and Difficulties, Intentional Electromagnetic Interference or IEMI.

Text Books:

1. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons, 2009
2. V.P. Kodali, “Engineering Electromagnetic Compatibility”, IEEE Publication, S. Chand & Co. Ltd., New Delhi.
3. Ralph Morrison, "Grounding and Shielding: Circuits and Interference”, John Wiley & Sons

Reference Books:

1. Henry W. Ott, “Electromagnetic Compatibility Engineering”, Wiley, 2009.
2. Clayton R. Paul, “Introduction to Electromagnetic Compatibility“, Wiley, 2006.

Course Title	Analog IC Design					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092404	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To Understand the concepts of Analog MOS devices and current mirror circuits
- To Design different configuration of Amplifiers and feedback circuits
  To Describe the characteristics of frequency response of the amplifier and its noise
  To Analyze te stability and frequency compensation techniques of Op-Amp Circuits
- To Construct switched capacitor circuits and PLLs

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

CO 1	Understand the concepts of Analog MOS devices and current mirror circuits
CO 2	Design different configuration of Amplifiers and feedback circuits
CO 3	Describe the characteristics of frequency response of the amplifier and its noise
CO 4	Analyze the stability and frequency compensation techniques of Op-Amp Circuits
CO 5	Construct switched capacitor circuits and PLLs

UNIT - I

Introduction to Analog IC Design and Current Mirrors: Concepts of Analog Design – General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors- Large and Small signal analysis- Common mode properties.

UNIT - II

Amplifiers and Feedback: Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.

UNIT - III

Frequency Response of Amplifiers and Noise: General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT - IV

Operational Amplifier Stability and Frequency Compensation: General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input

range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multi pole system- Phase margin- Frequency compensation- Compensation of two stage op Amps- Other compensation techniques.

UNIT - V

Switched Capacitor Circuits and PLLs: General Considerations- Sampling switches- Switched Capacitor Amplifiers-Switched Capacitor Integrator-Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL-Charge pump PLLs-Non ideal Effects in PLLs-Delay locked loops- its Applications.

Text Book:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits‖, Tata McGraw Hill, 2001, 33rd re-print, 2016.

Reference Books:

1. Phillip Allen and Douglas Holmberg, CMOS Analog Circuit Design‖ Second Edition, Oxford University Press, 2004.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009
3. Grebene, Bipolar and MOS Analog Integrated circuit design‖, John Wiley & sons, Inc., 2003

Course Title	Digital IC Design					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092405	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To Understand the basics of MOS Design.
- To Understand the basics of Combinational MOS Logic Circuits and the basics of Sequential MOS Logic Circuits.
- To Understand concepts of different interconnection techniques.
- To Describe concepts of Semiconductor memories and RAM array Organization.

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

CO 1	Understand the basics of MOS Design
CO 2	Understand the basics of Combinational MOS Logic Circuits and the basics of Sequential MOS Logic Circuits
CO 3	Analyze concepts digital integrated circuits and its applications
CO 4	Understand concepts of different interconnection techniques
CO 5	Describe concepts of Semiconductor memories and RAM array Organization

UNIT - I:

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II:

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates, Multiplers.

UNIT-III:

Sequential MOS Logic Circuits: Behaviour of bi stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT-IV:

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits. Interconnect:Capacitive Parasitics, Resistive Parasitics, InductiveParasitics, Advanced Interconncet Techniques, clock distribution networks , clock delays, clock skew and Jitter.

UNIT-V:

Flash Memory, RAM array organization. Semiconductor Memories: Memory Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash.

Text Books:

1. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.
2. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
3. Modern VLSI Design-Wayne Wolf, fourth edition, copyrights 2009.

Course Title	Biomedical Signal Processing					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092406	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand the origin, properties of biomedical signals like ECG, EEG, PCG, ENG, EOG signals, modern filtering techniques.
- To apply filters to remove noise, signal compression techniques & averaging technique on biomedical signals to extract the features of ECE, EEG and EMG signals.
- To analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG, EEG, and EMG signals. Also compare different filtering techniques.
- To develop an interest to simulate the models and validate its functionality in real time systems.

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

CO 1	Understand the origin, properties of biomedical signals like ECG, EEG, PCG, ENG, EOG signals, modern filtering techniques.
CO 2	Apply filters to remove noise, signal compression techniques & averaging technique on biomedical signals to extract the features of ECE, EEG and EMG signals.
CO 3	Analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG, EEG, and EMG signals. Also compare different filtering techniques.
CO 4	Develop an interest to simulate the models and validate its functionality in real time systems.

UNIT - I

Preliminaries: Concept of Biological signals – Electrical, Mechanical, Chemical, Magnetic, Optical etc. Origin of electrical signal from Biological cell – Structure of Biological cell, Characteristics of Cell membrane, Distribution and movement of ions across the cell membrane, Generation of Biological cell Action Potential. Concept of Electrocardiogram (ECG), Electroencephalogram (EEG), Phonocardiogram (PCG), Electromyogram (EMG), Electroneurogram (ENG), Electrooculogram (EOG), Respiratory signals etc.

UNIT – II

Signal Conditioning: Band limiting of different Biological signals, Representation of biological signals in analog, discrete and digital forms.

Filtering for Removal of artifacts - Statistical Preliminaries, Time domain filtering - Synchronized Averaging, Moving Average Filter to Integration, Derivative-based operator, **Frequency Domain Filtering** – FIR and IIR methods for implementing Notch, band selective filters, Weiner, Adaptive Filtering concepts.

UNIT - III

Electrocardiogram (ECG) Analysis: Concepts of morphological and rhythm analysis, Different types of arrhythmias, Derivative based Approaches for QRS Detection, Pan Tompkins Algorithm, Concepts of detecting the P, T waves, PR, ST intervals, QRS duration, etc. Heart Rate Variability (HRV) study and its importance.

UNIT - IV

EEG, EMG signals Analysis: Basics of EEG and EMG signals. Signal strength, Signal entropy in time and frequency domain, Correlation coefficient, Envelop Extraction, Root Mean Square value, Zero-crossing rate, Form factor, Periodogram, Minimum phase correspondent, Power Spectral Density concepts in analyzing EEG and EMG signals.

UNIT - V

Modelling of Biomedical Systems: Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients, ARMA model, Sequential estimation of poles and zeros.

Text Books

1. R M Rangayyan "Biomedical Signal Analysis: A case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002.
2. Willis J. Tompkins, "Biomedical Digital Signal Processing", EEE, PHI, 2004.
3. D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005.

Reference Books

1. Suresh R Devasahayam, "Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing", Springer, 3rd Edition, 2019.
2. J G Webster "Medical Instrumentation: Application & Design", John Wiley & Sons Inc., 2001.

Course Title	Embedded System Design with ARM					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092407	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand architectures and instruction set of ARM controller.
- To Write programs using ARM instructions.
- To Interface various sensors and actuators with ARM controller.
- To Design an Embedded system.

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

CO 1	Understand architectures and instruction set of ARM controller.
CO 2	Write programs using ARM instructions.
CO 3	Interface various sensors and actuators with ARM controller.
CO 4	Design an Embedded system.

UNIT - I

Introduction To Embedded Systems: Introduction, Design Considerations of Embedded Systems, Microprocessors and Microcontrollers, Architecture of ARM Microcontroller, ARM Instruction Set.

UNIT - II

ARM Board: The STM32F401 Nucleo Board, PWM And Interrupt on STM32F401, Digital To Analog Conversion, Analog To Digital Conversion, Output Devices, Sensors and Actuators.

UNIT - III

Interfacing-I: Microcontroller Development Boards, EMbed C Programming Environment, Interfacing With STM32F401 Board, Interfacing With Arduino Uno, Interfacing 7-Segment LED And LCD Displays, Serial Port Terminal Application.

UNIT - IV

Interfacing-II: Interfacing Temperature Sensor, Interfacing LDR Light Sensor, Interfacing Speaker, Interfacing Microphone, Design of Control System, Interfacing Relay, Interfacing DC Motor, Interfacing Multiple Sensors And Relay.

UNIT - V

Interfacing-III: Introduction, GSM And Bluetooth, Design of A Home Automation System, Design Of A Simple Alarm System Using Touch Sensor, Accelerometer, Interfacing Accelerometer, Interfacing Bluetooth, Interfacing Gas Sensor.

Text Books:

1. F. Vahid and T. Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India Pvt. Ltd., 2002.
2. A.N. Sloss, D. Symes and C. Wright, “ARM System Developer’s Guide: Design and Optimizing System Software”, Morgan Kaufman Publishers, 2004.

Reference Books:

1. W. Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2008.
2. Steve Furber, “ARM System-on-Chip Architecture”, Addison Wesley, 2nd edition.

NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
2. https://nptel.ac.in/courses/106/105/106105193/

Course Title	Information Theory &Coding				Honours Degree			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092408	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand various information measures
- To describe various information channels
- To use different source code algorithms
- To Analyze quantization and transform coding.

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

CO 1	Understand various information measures
CO 2	Describe various information channels
CO 3	Use different source code algorithms
CO 4	Analyze quantization and transform coding.

UNIT - I

Information Theory: Introduction to Information Theory and Coding, Definition of Information Measure and Entropy, Extension of An Information Source and Markov Source, Adjoint of An Information Source, Joint and Conditional Information Measure, Properties of Joint and Conditional Information Measures and A Morkov Source Properties of Joint and Conditional Information measures and a Markov source.

UNIT - II

Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property, Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding.

UNIT - III

Information Channels I: Introduction to Information Channels, Equivocation and Mutual Information, Properties of Different Information Channels, Reduction of Information Channels, Properties of Mutual Information and Introduction to Channel Capacity, Calculation of Channel Capacity for Different Information Channels, Shannon's Second Theorem.

UNIT - IV

Information Channels II: Error Free Communication Over Noisy Channel, Error Free Communication Over A Binary Symmetric Channel and Introduction to Continuous Sources and Channels, Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels, Channel Capacity of A Band Limited Continuous Channel

UNIT - V

Quantization: Introduction to Quantization, Lloyd-Max Quantizer, Companded Quantization, Variable Length Coding and Problem Solving in Quantizer Design, Vector Quantization, Transform Coding-Idea of Transform Coding, Choosing the weights of basis vector, forward transform, Energy preserving, Optimal bit allocation .

Text Books:

1. T. M. Cover, J. A, Thomas, "Elements of information theory," Wiely Interscience, 2 nd Edition, 2006
2. R. W. Hamming, "Coding and information theory," Prentice Hall Inc., 1980.

Reference Books:

1. Bose, "Information Theory, Coding and Cryptography", Mcgraw hill Education
2. S. Gravano, "Introduction to Error Control Codes", OUP Oxford (24 May 2001)
3. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990)
4. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms", Wiley, 2005.

Course Title	DSP Algorithms & Architectures					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092409	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand Aspects of architectures.
- To understand Memory mapped accelerators
- To analyze DSP algorithms
- To map the algorithms to architectures

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

CO 1	Understand Aspects of architectures.
CO 2	Understand Memory mapped accelerators
CO 3	Analyze DSP algorithms
CO 4	Map the algorithms to architectures

UNIT - I

DSP System Models: Introduction- Review of digital logic, Timing and Power in digital circuits, Quality metrics and bounds - Implementation Costs and Metrics, Architecture cost components, Examples of Architectures, Multi-objective Optimization.

Number representation- Scientific notation and Floating point

FIR and IIR Implementation: FIR filter, Serial FIR filter architectures, Simple programmable architecture, Block diagrams and SFGs, Dataflow Graphs, Iteration period, FIR filter iteration period, IIR filter iteration period, Computation Model

UNIT - II

Dedicated hardware and transforms – Implementation, Constraint analysis for IPB computation, Motivational examples for IPB, General IPB computation, Sample period calculation, Parallel architecture, Odd-even register reuse, Power consumption, Pipelining, Pipelining FIR filter, Time-invariant systems, Valid pipelining examples, Feed forward cut-sets, Balanced pipeline, Retiming basic concept,Example and uses of retiming

Resource sharing: adder example, Changing iteration period, Hardware assumptions and constraint analysis, Mathematical formulation, Examples with formulation, Example: Biquad filter, Hardware architecture, Review biquad folding sets, Completebiquad hardware,

UNIT - III

Scheduling: Obtaining a folding schedule, ASAP schedule, Utilization Efficiency, ALAP schedule, Iteration period bound and scheduling, Retiming for scheduling, Blocked schedules, Overlapped schedules, mproved blocked schedule, Allocation, Binding and Scheduling, Heuristic approaches to scheduling, Mathematical formulation, ILP formulation, List scheduling, Hardware model, Force Directed Scheduling.

UNIT - IV

Programmable Sytems: Software Compilation, Optimization Examples, Loop optimizations, Software pipelining, FFT Optimization, CPUs and FPGAs, FFT on FPGA board, Understanding ELF files

UNIT - V

Memory and Communication Systems: On-chip communication basics, Many-to-Many communication, AXI bus handshaking, HW accelerator for FPGA, DMA and arbitration, Network-on-chip basics, NoC - topologies and metrics, NoC– routing, NoC - switching and flow control,

Specialized Architectures: Systolic Arrays – Background, CORDIC algorithm, Parallel implementation of FIR filters, Unfolding Transformation, Look ahead Transformation, Introduction to GPUs and Matrix multiplication

Text Books:

1. KK Parhi, "VLSI Digital Signal Processing Systems: Design and Implementation", Wiley, NY, 1999.
2. Lars Wanhammar, Academic Press, 1999.

Reference Books:

1. Peter Pirsch, "Architectures for Digital Signal Processing", 2nd edition, John Weily, 2007
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", 2 Edition, TMH, 2004.
3. Jervis, "Digital Signal Processing- A practical approach", 4th edition, Pearson Education,2004.

Course Title	Low Power VLSI Design					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092410	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand leakage sources and reduction techniques.
- To characterize and model power consumption & understand the basic analysis methods.
- To identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.

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

CO 1	Understand leakage sources and reduction techniques.
CO 2	Characterize and model power consumption & understand the basic analysis methods.
CO 3	Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.

UNIT -I

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd&Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

UNIT -II

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

UNIT -III

Low Power Clock Distribution: Power dissipation in clock distribution, single driver Versus distributed buffers, buffers & device sizing under process variations, zero skew Vs. Tolerable skew, chip & package co-design of clock network.

UNIT -IV

Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

UNIT -V

Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Text Books

1. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer
2. Academic, 2002
3. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley
4. sonsInc.,2000.
5. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.

Reference Books:

1. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”,
2. Kluwer,1995
3. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

Course Title	RF Integrated Circuits				Honours Degree			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092411	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand different RF Components such as Passive components, Microstri Transmission Line.
- To design RF Amplifiers-High gain, Low gain Minimum Noise Amplifiers.
- To design of RF Oscillators.
- To design of RF Converters, Mixers.
- To design of Matching networks for RF Circuits.

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

CO 1	Understand different RF Components such as Passive components, Microstrip Transmission Line.
CO 2	Design RF Amplifiers-High gain, Low gain Minimum Noise Amplifiers.
CO 3	Design of RF Oscillators.
CO 4	Design of RF Converters, Mixers.
CO 5	Design of Matching networks for RF Circuits.

UNIT - I

RF systems: basic architectures, Transmission media and reflections, Maximum power transfer, Passive RLC Networks - Parallel RLC tank, Q, Series RLC networks, matching, Pi match, T match, Passive IC Components, Interconnects and skin Effect, Resistors, capacitors, Inductors

UNIT - II

Review of MOS devices: Distributed Systems- transmission lines, reflection coefficient, The wave equation, examples, Lossy transmission lines, Smith charts – plotting gammaTime Domain Methods for Speech Processing: Time domain parameters of speech, methods for extracting the parameters: Zero crossings, Auto-correlation function, pitch estimation. Analysis and Synthesis of Pole-Zero Speech Models

UNIT - III

High Frequency Amplifier Design: Bandwidth estimation using open-circuit time constants, Bandwidth estimation using short-circuit time constants, Rise time, delay and bandwidth, Zeros to enhance bandwidth, Shunt-series amplifiers, tuned amplifiers, Cascaded amplifiers. Noise- Thermal noise, flicker noise review, Noise figure, LNA Design - Intrinsic MOS noise Parametes, Power match versus noise match, Large signal performance, design examples & Multiplier based mixers. Mixer Design – Sub sampling mixers.

UNIT - IV

RF Power Amplifiers: Class A, AB, B, C Amplifiers, Class D, E, F amplifiers, RF Power amplifier design examples. Voltage controlled oscillators – Resonators, Negative resistance Oscillators.

UNIT - V

Phase locked Loop: Linearized PLL models, Phase detectors, charge Pumps, Loop filters, PLL design Examples. Frequency synthesis and oscillators - Frequency division, integer-N synthesis, Fractional frequency synthesis. Phase noise - General considerations, Circuit examples. Radio architectures - GSM radio architectures, CDMA, UMTS radio architectures

Text Books:

1. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004.
2. BehzadRazavi, "RF Microelectronics", Prentice Hall, 1997.

Reference Books:

1. Ellinger, Frank, "Radio Frequency Integrated Circuits and Technologies", Springer, 2008.
2. Cam Nguyen, "Radio-Frequency Integrated-Circuit Engineering",John Wiley & Sons, 2015.

Course Title	Principles of Signal Estimation for MIMO/ OFDM Wireless Communication					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092412	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand MIMO Communication Systems and OFDM.
- To compare MIMO Systems with Single Input Single Output (SISO) Systems.
- To analyse the Information Theoretic advantages of MIMO Systems.
- To analyse the spatial multiplexing properties of MIMO .

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

CO 1	Understand MIMO Communication Systems and OFDM
CO 2	Compare MIMO Systems with Single Input Single Output (SISO) Systems
CO 3	Analyse the Information Theoretic advantages of MIMO Systems
CO 4	Analyse the spatial multiplexing properties of MIMO

UNIT - I

MIMO Introduction: Basics of Estimation, Maximum likelihood, Information Theoretic aspects of MIMO Review of SISO fading communication channels, MIMO channel models, Classical i.i.d. and extended channels, Frequency selective and correlated channel models, Capacity of MIMO channels, Ergodic and outage capacity, Capacity bounds and Influence of channel properties on the capacity.

UNIT - II

MIMO Diversity: Spatial Multiplexing Sources and types of diversity, analysis under Rayleigh fading, Diversity and channel knowledge. Alamouti space time code, MIMO spatial multiplexing.Space time receivers. ML, ZF, MMSE and Sphere decoding, BLAST receivers and Diversity multiplexing trade-off.

UNIT- III

Space Time Trellis Codes: Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

UNIT - IV

Wireless fading channel Estimation: Cramer-rao bound for Estimation, vector parameter Estimation, Properties of Estimation, Multi-antenna Wireless channel Estimation. MEMO Wireless channel Estimation, Error covariance of Estimation, Equalization for frequency selective channels.

UNIT - V

OFDM Estimation: sequential estimation, Minimum Mean-square Error (MMSE), Estimate Gaussian parameter, Wireless sensor network, wireless fading channel estimation.

MMSE for MIMO Channel estimation properties of Estimation, MMSE for equalization of wireless Channel, MMSE of OFDM Channel estimation.

Text Books :

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press 2005
2. Hamid Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press 2005.

Reference Books:

1. Paulraj, R. Nabar and D. Gore, " Introduction to Space-Time Wireless Communications", Cambridge University Press 2003
2. E.G. Larsson and P. Stoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press 2008
3. EzioBiglieri , Robert Calderbank et al "MIMO Wireless Communications" Cambridge University Press 2007

Course Title	Statistical Signal Processing					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092413	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To generalize the properties of statistical models in the analysis of signals using Stochastic processes.
- To differentiate the prominence of various spectral estimation techniques for achieving higher resolution in the estimation of power spectral density.
- To outline various parametric estimation methods to accomplish the signal modeling even at higher order statistics.
- To design and development of optimum filters using classical and adaptive algorithms.
- To extrapolate the importance of least squares techniques and decomposition methods in analyzing the signal estimations.

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

CO 1	Generalize the properties of statistical models in the analysis of signals using Stochastic processes.
CO 2	Differentiate the prominence of various spectral estimation techniques for Achieving higher resolution in the estimation of power spectral density.
CO 3	Outline various parametric estimation methods to accomplish the signal modeling even at higher order statistics.
CO 4	Design and development of optimum filters using classical and adaptive algorithms.
CO 5	Extrapolate the importance of least squares techniques and decomposition methods in analyzing the signal estimations.

UNIT - I

Introduction: Stationary processes: Strict sense and wide sense stationarity; Correlation and spectral analysis of discrete-time wide sense stationary processes, white noise, response of linear systems to wide-sense stationary inputs, spectral factorization.

UNIT - II

Parameter estimation: Properties of estimators, Minimum Variance Unbiased Estimator (MVUE Cramer Rao bound, MVUE through Sufficient Statistics, Maximum likelihood estimation- properties. Bayseaen estimation- Minimum Mean-square error (MMSE) and Maximum a Posteriori (MAP) estimation.

UNIT - III

Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear minimum mean-square error(LMMSE) estimation, orthogonality principle and Wiener Hoff equation,FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-

Durbin Algorithm, application –linear prediction of speech, Non-causal IIR wiener filter, Causal IIR Wiener filtering.

UNIT - IV

Iterative and adaptive implementation of FIR Wiener filter: Steepest descent algorithm, LMS adaptive filters, convergence analysis, least-squares(LS) method, Recursive LS (RLS) adaptive filter, complexity analysis, application- neural network.

UNIT - V

Kalman filters: Gauss -Markov state variable models; innovation and Kalman recursion, steady-statebehaviour of Kalman filters.

Text Books:

1. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons, Inc., 2002.
2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall,1993.
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Reference Books:

1. Umberto Spagnolini, "Statistical Signal Processing in Engineering", John Wiley & Sons, 2018.
2. Robert M. Gray,Lee D. Davisson, "An Introduction to Statistical Signal Processing", Cambridge University Press, 2004.

Course Title	Op-Amp Practical Applications: Design, Simulation and Implementation					Honours Degree		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2092414	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives

- To understand the operational amplifiers with linear integrated circuits.
- To Identify positive feedback amplifier applications of op-amp.
- To Design circuits using operational amplifiers for various applications.

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

CO 1	Understand the operational amplifiers with linear integrated circuits.
CO 2	Identify positive feedback amplifier applications of op-amp.
CO 3	Design circuits using operational amplifiers for various applications.

UNIT - I

Introduction to Operational Amplifier: Data sheets of Operational amplifier, ideal Characteristics, effect of loading, input impedance, concept of hysteresis, need of hysteresis for switching circuits.

UNIT -II

Op-amp practical applications: Analog to digital converters, Digital to analog converters, function generator capable of generating square wave and triangular wave.

UNIT -III

Positive feedback amplifier op-amp applications: Window comparator, Inverting Schmitt trigger, non-inverting Schmitt trigger, Astable multivibrator, Monostable multivibrator, voltage controlled voltage source.

UNIT -IV

Temperature controlled applications using op-amp: Design and development of temperature controlled circuit using op-amp for ON/OFF, Implementation of PI controller,

UNIT -V

Data acquisition applications using op-amp: Signal conditioning unit for thermocouple, Introduction to ECG experiment, peak detector and thresholding for ECG signal conditioning.

Text Books:

1. Gray, Hurst, Lewis, and Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 5th edition, 2009
2. Horowitz and Hill, "The Art of Electronics", Cambridge Univ. Press, 1999
3. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, 2001

Reference Books:

1. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2nd edition, 2002
2. Johan H. Huijsing, "Operational Amplifiers – Theory and Design", 3rd edition, Springer
3. Razavi, "Fundamentals of Microelectronics", John Wiley, 2008.

Course Title	Multirate DSP					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092415	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.
- To describe basic sampling rate conversion algorithms.
- To design sampling rate converters.
- To analyze the interpolated FIR filters.

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

CO 1	Understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.
CO 2	Describe basic sampling rate conversion algorithms.
CO 3	Design sampling rate converters.
CO 4	Analyze the interpolated FIR filters.

UNIT - I

Introduction: Overview of Sampling and Reconstruction, Review of Discrete-Time Systems and Review of digital filters

UNIT - II

Fundamentals of Multirate Theory: The sampling theorem – sampling at sub 88 yquist rate – Basic Formulations and schemes. Basic Multirate operations- Decimation and Interpolation – Digital Filter Banks- DFT Filter Bank- representation Maximally decimated filter banks: Polyphase representation – Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank – Design of an alias free QMF Bank decimator.

UNIT - III

Filter Banks I:M-channel perfect reconstruction filter banks Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems.

UNIT - IV

Filter Banks II: Perfect reconstruction (PR) filter banks Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

UNIT - V

Filter Banks III: Cosine Modulated filter banks Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems

Text Books

1. P.P. Vaidyanathan. “Multirate systems and filter banks.” Prentice Hall.PTR. 1993.
2. N.J. Fliege. “Multirate digital signal processing .”John Wiley 1994.
3. Sanjit K. Mitra. “ Digital Signal Processing: A computer based approach.” McGraw Hill. 1998.

Reference Books:

1. R.E. Crochiere. L. R. “Multirate Digital Signal Processing”, Prentice Hall. Inc.1983.
2. J.G. Proakis. D.G. Manolakis. “Digital Signal Processing: Principles. Algorithms and Applications”, 3rd Edn.Prentice Hall India, 1999. EC6301: Random Process.

Course Title	Digital VLSI Testing					Honours Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2092416	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		4	-	--	4	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives

- To understand the different types of testing and its importance
- To apply design for testability and design rules.
- To identify various test pattern generations
- To compare the fault models and test techniques

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

CO 1	Understand the different types of testing and its importance
CO 2	Apply design for testability and design rules.
CO 3	Identify various test pattern generations
CO 4	Compare the fault models and test techniques

UNIT - I

Introduction to Testing: Introduction, Importance, Challenges, Levels of abstraction, Fault Models, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing.

UNIT - II

Design for Testability: Introduction, Testability Analysis, DFT Basics, Scan cell design, Scan Architecture, Design for Testability: Scan design rules, Scan design flow Fault Simulation: Introduction, Simulation models

UNIT - III

Fault Simulation: Logic simulation, Fault simulation, Test Generation: Introduction, Exhaustive testing, Boolean difference, Basic ATPG algorithms, Test Generation: ATPG for non stuck-at faults, other issues in test generation.

UNIT - IV

Built-In-Self-Test: Introduction, BIST design rules, Built-In-Self-Test: Test pattern generation, Output response analysis, Logic BIST architectures. Test Compression: Introduction, Stimulus compression, Response compression.

UNIT - V

Memory Testing: Introduction, RAM fault models, RAM test generation, Memory Testing: Memory BIST Power and Thermal Aware Test: Importance, Power models, Low power ATPG, Power and Thermal Aware Test: Low power BIST, Thermal aware techniques.

Text Books

1. M.L. Bushnell, V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits” Kluwer Academic Publishers.
2. P. K. Lala,” Digital circuit Testing and Testability”, Academic Press. 1997.

Reference Books

1. M. Abramovici, M. A. Breuer and A.D Friedman, “Digital Systems and Testable Design”, Jaico Publishing House.
2. N. Jha& S.D. Gupta, “Testing of Digital Systems”, Cambridge, 2003.

Course Title	DATA SCIENCE				B.Tech CSE - V Sem (Honours Degree)		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
2092501	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				**End Exam Duration: 3Hrs**			

Course Objectives:

- Introduce R as a programming language
- Introduce the mathematical foundations required for data science
- Introduce the first level data science algorithms
- Introduce a data analytics problem solving framework

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

CO 1	Describe a flow process for data science problems (Remembering)
CO 2	Classify data science problems into standard typology (Comprehension)
CO 3	Develop R codes for data science solutions (Application)
CO 4	Correlate results to the solution approach followed (Analysis)
CO 5	Assess the solution approach (Evaluation)
CO 6	Construct use cases to validate approach and identify modifications required (Creating)

UNIT-I

R–Programming: Introduction to R, variables and datatypes In R, data frames, recasting and joining of dataframes, arithmetic, logical and matrix operations in R, functions, control structures, data visualization in R basic graphics.

UNIT-II

Linear Algebra: Linear algebra for data science, solving linear equations, Linear algebra – distance, hyperplanes and half-spaces, Eigenvalues, Eigenvectors, statistical modeling, random variables and probability mass/density functions, sample statistics, hypotheses testing.

UNIT-III

Optimization: Optimization for data science, unconstrained multivariate optimization, Gradient Descent learning rule, multivariate optimization with equality constraints, multivariate optimization with inequality constraints. Introduction to data science, solving data analysis problems – a guided thought process.

UNIT-IV

First level data science algorithms: Predictive modeling, linear regression, model assessment, diagnostics to improve linear model fit, simple linear regression model building, simple linear regression model assessment, multiple linear regression.

UNIT-V

Regression Analysis: Cross validation, multiple linear regression modeling building and selection, classification, logisitic regression, performance measures, logistic regression implementation in R, K-nearest neighbors, K-nearest neighbors implementation in R, K-means clustering, K-means implementation in R.

Text Books:

1. Introduction to Linear Algebra – by Gilbert Strang
2. Applied Statistics and Probability for Engineers – by Douglas Montgomery
3. R Programming for Data Science – by Roger D. Peng

Reference Books:

1. Data Science, John D. Kelleher, Brendan Tierney, MIT Press.
2. R in Action Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publications, 2011.
3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, O'Reilly Meida.

Web Links:

1. https://nptel.ac.in/courses/106/106/106106179/

Course Title	Computer Architecture and Organization				B.Tech CSE - V Sem (Honours Degree)		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
2092502	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				**End Exam Duration: 3Hrs**			

Course Objectives:

- To make the students to understand the structure of computers and internal organization of different units like memory, I/O devices and registers.
- To Study the basic concepts of computer architecture and organization.
- To study in detail about the operation of control unit and Arithmetic unit.

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

CO 1	Understand the basic concepts of computer architecture and organization
CO 2	Understand the design of the control unit and memory organization
CO 3	Understand the design of Adders, Multipliers and Dividers
CO 4	Understand the basic concepts of pipelining and Vector processor
CO 5	Use of memory and I/O devices effectively and to explore requirements of cache Memory and Multiprocessors

UNIT-I

Basic Computer Organization and Design: Evolution of Computer Systems, Basic Operation of a Computer, Memory Addressing and Languages, Software and Architecture Types, Instruction Set Architecture, Number Representation, Instruction format and Addressing Modes, CISC and RISC Architecture.

UNIT-II

Control Unit: Measuring CPU Performance, Design of control unit.

Memory Organization: Processor memory interaction, Static and Dynamic RAM, Asynchronous DRAM, Synchronous DRAM, Memory interfacing and addressing, Memory hierarchy design, Cache Memory, Improving cache performance.

UNIT-III

Computer Arithmetic: Design of Adders, Design of Multipliers, Design of Dividers, Floating point numbers, Floating point arithmetic.

Pipelining and Vector Processing: Parallel processing, Pipelining, Arithmetic pipeline, Instruction Pipeline, Vector Processing.

UNIT-IV

Input – Output Organization: Secondary storage devices, Input Output Organization, Data transfer techniques, Interrupt handling, Dynamic Memory Access.

UNIT-V

Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Inter Processor Communication and synchronization.

Text Books:

1. D.A.Patterson and J.L.Hennessy," ComputerArchitecture:AQuantitative approach, 5/E", Morgan KoFFman, 2011
2. Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI.
3. William Stallings,"Computer Organization and Architecture: Designing for Performance",-Tenth Edition, Pearson/PHI, 2015.
4. Carl Hamacher, ZvonksVranesic, SafeaZaky,,"Computer Organization,5/E",Vth Edition, McGraw Hill,2011.

Reference Books:

1. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.
2. Fundamentals of Computer Organization and Design, - SivaraamaDandamudi, Springer Int. Edition.
3. Computer Architecture a quantitative approach, John L. Hennessy and David A. Patterson, Fourth Edition, Elsevier.
4. Computer Architecture: Fundamentals and principles of Computer Design, Joseph D. Dumas II, BS Publication.

Course Title	APPLIED MACHINE LEARNING IN PYTHON				B.Tech CSE - VI Sem (Honours Degree)		
Course Code	Hours/Week			Credits	Maximum Marks		
2092503	L	T	P	C	Continuous Internal Assessment	End Exams	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				End Exam Duration: 3Hrs			

Course Objectives:

- Understand the Machine Learning Basic concepts.
- Understand the need of python in machine learning.
- To Analyse Supervised Learning Algorithms.

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

CO 1	students will be able to identify the difference between a supervised (classification) and unsupervised (clustering) technique
CO 2	Understand Supervised Learning Algorithms.
CO 3	Identify which technique they need to apply for a particular dataset and need, engineer features to meet that need, and write python code to carry out an analysis.

UNIT-I

Machine learning basics: The need for Machine learning, understanding machine learning, machine learning methods, Supervised learning, Un supervised learning, semi supervised learning, reinforcement learning.

UNIT-II

The Python Machine Learning Ecosystem: Python Introduction, strengths, pitfalls, setting up a python Environment, Why Python for Data science.

Introducing the Python Machine Learning Ecosystem: Jupiter notebooks, Numpy, Pandas.

UNIT-III

Processing, Wrangling and Visualizing data: Data collection, Data description, Data Wrangling, data Summarization, Data Visualization.

UNIT-IV

Machine Learning Algorithms: Introduction to Classification, **Logistic Regression**: Introduction, Types of Logistic Regression, Binary Logistic regression Model, Multinomial Logistic regression Model, **Support vector machine:** Introduction to SVM, Pros and Cons of SVM classifier.

UNIT-V

Classification Algorithms: Decision Tree, Naïve-Bayes, Random Forest.

Case studies: Analyzing Bike sharing Trends.

Text Books:

1. Practical Machine Learning with Python- A problem solver's Guide to Building Real world intelligent Systems, Dipanjan Sarkar, Raghav Bali, Tushar Sharma.Apress publications.
2. Introduction to Machine Learning with Python- A Guide for Data Scientists, Andreas C.Miiller and sarah Guido, O'REILLY publications.

Reference Books:

1. Machine Learning with Python tutorials point.www.tutorialspoint.com
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron
3. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili

Course Title	DEEP LEARNING				B.Tech CSE - VI Sem (Honours Degree)		
Course Code	Hours/Week			Credits	Maximum Marks		
2092504	L	T	P	C	Continuous Internal Assessment	End Exams	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				End Exam Duration: 3Hrs			

Course Objectives:

- Study about basic concepts of deep learning
- Introduce deep learning algorithms, te problem settings and their applications to solve real world problems.

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

CO 1	Understand the historical trends in deep learning and use Tensor flow for performing Linear Regression, Gradient Descent, optimizers, graph visualization and training curves.
CO 2	Summarize the fundamentals of Artificial Neural Networks.
CO 3	Understand the training of Deep Neural Nets
CO 4	Understand the Convolutional Neural Networks Architecture.
CO 5	Understand the Recurrent Neural Networks and deep RNN training.

UNIT-I

Introduction to Deep Learning: Introduction, Historical trends in Deep Learning

Up and Running with TensorFlow: Installation, Creating Your First Graph and Running It in a Session, Managing Graphs, Lifecycle of a Node Value, Linear Regression with TensorFlow. Implementing Gradient Descent, Feeding Data to the Training Algorithm, Saving and Restoring Models, Visualizing the Graph and Training Curves Using TensorBoard, Name Scopes, Modularity, Sharing Variables.

UNIT-II

Introduction to Artificial Neural Networks: From Biological to Artificial Neurons, Training an MLP with TensorFlow's High-Level API, Training a DNN Using Plain TensorFlow, Fine-Tuning Neural Network Hyperparameters.

UNIT-III

Training Deep Neural Nets: Vanishing/Exploding Gradients Problems, Reusing Pretrained Layers, Faster Optimizers, Avoiding Over fitting Through Regularization.

UNIT-IV

Convolutional Neural Networks: The Architecture of the Visual Cortex, Convolutional Layer, Pooling Layer., CNN Architectures : LeNet5, AlexNet, GoogLeNet, ResNet.

UNIT-V

Recurrent Neural Networks Recurrent Neurons, Basic RNNs in TensorFlow, Training RNNs, Deep RNNs.

Text Books:

1. "Deep Learning" Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press book.
2. "Hands-On Machine Learning with Scikit-Learn and TensorFlow" March 2017: First Edition

Reference Books:

1. "Neural Networks and Deep Learning", Michael Nielsen.
2. "Neural Networks and Deep Learning " Aggarwal, Charu C.Springer International Publishing.

Web References:

1. https://www.coursera.org/specializations/deep-learning?
2. https://www.coursera.org/learn/introduction-tensorflow?

<table>
<tr><td>Course Title</td><td colspan="2">INTRODUCTION TO BLOCKCHAIN TECHNOLOGIES AND APPLICATIONS</td><td colspan="3">B.Tech CSE - VII Sem (Honours Degree)</td></tr>
<tr><td>Course Code</td><td>Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2092505</td><td rowspan="2">MOOC</td><td rowspan="2">2</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="6">Course Objectives:
Understand how block chain systems work
To securely interact with them
Integrate ideas from block chain technology into their own projects</td></tr>
<tr><td colspan="6">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="5">Recall cryptographic concepts, hashing, public key cryptosystems.</td></tr>
<tr><td>CO 2</td><td colspan="5">Understand basic concept of Block chain technology</td></tr>
<tr><td>CO 3</td><td colspan="5">Understand design principles of Bitcoin and Alternative coins</td></tr>
<tr><td>CO 4</td><td colspan="5">Study on the usecases of Block chain technology.</td></tr>
</table>

UNIT-I

Introduction – basic ideas behind blockchain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Introduction to BitcoinBlockchain.

UNIT-II

BitcoinBlockchain and scripts, Use cases of BitcoinBlockchain scripting language in micropayment, escrow etc Downside of Bitcoin – mining.

UNIT-III

Alternative coins – Ethereum and Smart contracts , IOTA, The real need for mining – consensus– Byzantine Generals Problem, and Consensus as a distributed coordination problem – Coming to private or permissioned blockchains.

UNIT-IV

Permissioned Blockchain and use cases – Hyperledger, Corda.

UNIT-V

Uses of Blockchain in E-Governance, Land Registration, Medical Information Systems.

Text Book:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies

Reference Books:

1. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
2. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
3. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Course Title	BIG DATA & HADOOP		B.Tech CSE - VII Sem (Honours Degree)		
Course Code	**Hours/Week**	**Credits**	**Maximum Marks**		
2092506	**MOOC**	2	**Continuous Internal Assessment**	**End Exams**	**Total**
			40	60	100
Mid Exam Duration: 90 Minutes		**End Exam Duration: 3Hrs**			

Course Objectives:

- To introduce big data concepts.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
- Understanding Hadoob.
- Understanding Big data Applications (HBASE, HIVE)
- To enable students to have skills that will help them to solve complex real-world problems in for decision support.

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

CO 1	Installation of Hadoop Tools.
CO 2	Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
CO 3	Working with HBASE and HIVE.
CO 4	Achieve adequate perspectives of big data in various applications like recommender systems, social media applications etc

UNIT-I

Introduction to Big Data: What is Big Data Why Big Data is Important, Meet Hadoop, Big Data Storage and Analysis, Comparison with other systems, Grid Computing, A brief history of Hadoop, Apache Hadoop and the Hadoop Eco system, Linux refresher VM Ware Installation of Hadoop.

UNIT-II

The design of HDFS: HDFS concepts, Command line interface to HDFS Hadoop File Systems, Interfaces Java Interface to Hadoop, Anatomy of a file read, Anatomy of a File Write, Replica placement and Coherency Model, Parallel copying with distep, Keeping an HDFS cluster balanced.

UNIT-III

Analyzing data with unix tools, Analyzing data with Hadoop, Java Map Reduce classes (New API). Data flow, combiner functions, Running a distributed MapReduce Job. Configuration API, Setting up the development environment. Managing configuration, Writing a unit test with MRunit, Running a Job in local job runner. Running on a cluste. Launching a job. The MapReduce WebUI.

UNIT-IV

Classic Mapreduce: Job submission, Job Initialization, Task Assignment, Task execution, Progress and status updates, Job Completion, Shuffle and sort on Map and reducer side, Configuration tuning. Map Reduce. Types, Input formats, Output formats, Sorting Map side and Reduce Side joins.

UNIT-V

The Hive Shall: Hive services, Hive clients, The meta store. Comparison with traditional databases, Hive QI.

Hbase: Concepts, Implementation, Java and Map reduce clients. Loading data, Web queries.

Text Books:

1. Tom White, Hadoop, "The Definitive Guide" , 3rd Edition, O'Reilly Publications, 2012
2. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Undetstanding Big Data Analytics for Enterprise class Hadoop and Streaming Data", 1st Edition, TMH, 2012.

Reference Books:

1. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.
2. Chuck Lam, Hadoop in Action, December, 2010.
3. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.
4. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.
5. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014.

Web links:

1. https://www.coursera.org/learn/hadoop#syllabus
2. https://www.coursera.org/lecture/hadoop/introduction-to-apache-hive-0AToF

Course Title	Introduction to Industry 4.0 and Industrial IOT		B.Tech CSE - VII Sem (Honours Degree)		
Course Code	**Hours/Week**	**Credits**	**Maximum Marks**		
2092507	**MOOC**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		2	40	60	100
Mid Exam Duration: 90 Minutes		**End Exam Duration: 3Hrs**			

Course Objectives:

- Introduction to Sensors, Communication and Networking
- Introducing Cyber Security in Industry 4.0
- To learn Big Data Analytics and SDN
- To know about various application domains

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

CO 1	Understanding various sensors in IoT
CO 2	Understanding Cyber Security with IIoT
CO 3	Understanding various application domains
CO 4	Build skills in Hardware, Software, Application Systems, and Data management

UNIT-I

Introduction: Sensing & actuation, Communication, Networking.

Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

UNIT-II

Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems.

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture.

UNIT-III

Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing, IIoT Communication. **Industrial IoT- Layers:** IIoT Communication, IIoT Networking. Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT-IV

Big Data Analytics and Software Defined Networks: SDN in IIoT, Data Center Networks, **Industrial IoT:** Security and Fog Computing: Cloud Computing in IIoT. Security and Fog

Computing - Fog Computing in IIoT, Security in IIoT, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT-V

Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Case studies. Self-Referential Structures and Introduction to Lists.

Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability
2. https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1
3. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
4. https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

Reference Books:

1. Research Papers

Web Link:

2. https://nptel.ac.in/courses/106/105/106105195/
3. nlinecourses.nptel.ac.in/noc24_cs95/preview

Course Title	Design and Implementation of Human Computer Interfaces		B.Tech CSE - VII Sem (Honours Degree)		
Course Code	**Hours/Week**	**Credits**	**Maximum Marks**		
2092508	**MOOC**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		2	40	60	100
Mid Exam Duration: 90 Minutes		**End Exam Duration: 3Hrs**			

Course Objectives:

- Understand the fundamental principles of human-computer interaction (HCI).
- Learn to design, implement, and evaluate user interfaces.
- Develop skills to create interfaces that improve user experience (UX) and usability.

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

CO 1	Demonstrate understanding of the fundamental concepts and history of HCI.
CO 2	Design interfaces that adhere to usability principles and enhance user experience.
CO 3	Utilize UCD techniques to conduct user research and apply findings to design processes.
CO 4	Conduct usability tests, analyze results, and iterate on designs based on user feedback.
CO 5	Apply knowledge of advanced topics such as mobile interfaces, AR/VR, and gesture-based interactions.
CO 6	Recognize and address ethical issues related to privacy, security, and social impact in interface design.

UNIT-I

Introduction to HCI: Overview of HCI, history, and evolution.

Principles of User Interface Design: Usability principles, cognitive psychology, affordances, and signifiers.

UNIT-II

User-Centered Design (UCD): User research methods, persona creation, use cases, task analysis.

Prototyping and Wireframing: Low-fidelity vs. high-fidelity prototypes, tools for wireframing, iterative design.

UNIT-III

Interaction Design: Design patterns, user flow, navigation design, error prevention.

Visual Design for Interfaces: Visual design principles, color theory, typography, design systems, and accessibility.

UNIT-IV

Evaluation and Usability Testing: Methods for usability testing, metrics, and data analysis.

Advanced Topics in HCI: Mobile and web design, gesture-based interfaces, voice-based interfaces, Emerging technologies (e.g: AR/VR, IoT).

UNIT-V

Ethical and Social Considerations: Privacy and security in HCI, Ethical issues in interface desing, Impact of technology on society and user behaviour.

TextBooks:

1. "Interaction Design: Beyond Human-Computer Interaction" by Jenny Preece, Yvonne Rogers, and Gillian Sharp, Wiley publisher, Current edition.
2. “The Design of Everyday Things”, Don Norman, Basic Books publisher.
3. “Don't Make Me Think: A Common Sense Approach to Web Usability”, Steve Krug, New Riders publisher.

Reference Books:

1. “Human-Computer Interaction: User-Centric Computing for Design”, Samit Bhattacharya. (2019), McGraw Hill Education (1st ed).
2. “Software Engineering: A Practitioner’s Approach”, Bruce R Maxim & Roger S Pressman (2019).. (8th ed), McGraw Hill Education.

Web Links:

1. Online resources and tutotials on UI/UX design tools
2. https://onlinecourses.nptel.ac.in/noc22_cs125/preview

Course Title	Reinforcement Learning		B.Tech CSE - VII Sem (Honours Degree)		
Course Code	**Hours/Week**	**Credits**	**Maximum Marks**		
2092509	**MOOC**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		2	40	60	100
Mid Exam Duration: 90 Minutes		**End Exam Duration: 3Hrs**			

Course Objectives:

- Learn the theoretical foundations of reinforcement learning (Markov decision processes & dynamic programming).
- Learn the algorithmic foundations of reinforcement learning (temporal difference and Monte- Carlo learning).
- Gain experience in framing low-dimensional problems and implementing solutions using tabular reinforcement learning.
- Learn about the motivation behind deep reinforcement learning and its relevance to high- dimensional applications, such as playing video games, and robotics.
- Discover the state-of-the-art deep reinforcement learning algorithms such as Deep Q Networks (DQN), Proximal Policy Optimisation (PPO), and Soft Actor Critic (SAC)

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

CO 1	Describe the core principles of autonomous systems learning.
CO 2	Calculate mathematical solutions to problems using reinforcement learning theory.
CO 3	Compare and contrast a range of reinforcement learning approaches.
CO 4	Propose solutions to decision making problems using knowledge of the state-of-the-art.
CO 5	Evaluate the performance of a range of methods and propose appropriate improvements.

UNIT-I

Introduction to Reinforcement Learning and its Mathematical Foundations, The Markov Decision Process Framework, Markov Reward Processes, The Policy, Markov Decision Processes

UNIT-II

Dynamic Programming, Model-Free Learning & Control, Monte-Carlo Learning, Temporal Difference Learning

UNIT-III

Motivation for function approximation, High-dimensional state and action spaces, Continuous state and action spaces

UNIT-IV

Deep Q-learning, Q update through back propagation, Experience replay buffer, Target and Q networks

UNIT-V

Policy gradients: The REINFORCE algorithm, Policy update through back propagation, Proximal Policy Optimization Advanced topics: Soft Actor Critic, Learning from demonstration, Model-based reinforcement learning

Text Books:

1. Optimal Control, Linear Quadratic Methods, Anderson and Moore. (1989).
2. Optimal control and reinforcement learning, Bertsekas. (2019)
3. Predictive control for linear and hybrid systems, Borrelli, Bemporad, and Morari. (2017).

Reference Books:

1. Reinforcement Learning, Sutton and Barto (2018).
2. Adaptive Filtering Prediction and Control, Goodwin and Kwai. (1984).

Course Title	Ethical Hacking		B.Tech CSE - VII Sem (Honours Degree)		
Course Code	**Hours/Week**	**Credits**	**Maximum Marks**		
2092510	**MOOC**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		2	40	60	100
Mid Exam Duration: 90 Minutes		**End Exam Duration: 3Hrs**			

Course Objectives:

- Understand the principles of ethical hacking and the role of ethical hackers.
- Learn to conduct reconnaissance and scanning to identify vulnerabilities.
- Master the use of ethical hacking tools and techniques.
- Develop skills in exploiting vulnerabilities and understanding their impact.
- Understand the legal and ethical considerations in ethical hacking.

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

CO 1	Explain the principles and practices of ethical hacking.
CO 2	Perform reconnaissance, scanning, and enumeration of network and application vulnerabilities.
CO 3	Use various ethical hacking tools and techniques to identify and exploit vulnerabilities.
CO 4	Assess and document security issues and provide remediation recommendations.
CO 5	Navigate the legal and ethical aspects of ethical hacking.

UNIT-I

Introduction to Ethical Hacking: Overview of ethical hacking, its role in security, and ethical considerations, Introduction to hacking methodologies and tools.

Footprinting and Reconnaissance: Techniques for gathering information about a target, Tools and methods for reconnaissance.

Scanning Networks: Techniques for network scanning, Introduction to scanning tools such as Nmap.

UNIT-II

Enumeration: Methods for identifying active devices and services on a network, Introduction to enumeration tools.

Vulnerability Assessment: Techniques for assessing vulnerabilities, Introduction to vulnerability assessment tools.

Exploitation Techniques: Methods and tools for exploiting vulnerabilities.

UNIT-III

Social Engineering: Understanding social engineering attacks, Techniques for manipulating individuals into revealing confidential information.

Web Application Security: Common web application vulnerabilities (e.g., SQL Injection, XSS). Tools and techniques for web application penetration testing.

Wireless Network Security: Vulnerabilities in wireless networks, Techniques for attacking and securing wireless networks.

UNIT-IV

Malware Analysis: Introduction to malware types and behaviors, Techniques for analyzing and mitigating malware threats.

Penetration Testing Methodologies: Structured approach to penetration testing. Phases of a penetration test: planning, testing, and reporting.

UNIT-V

Report Writing and Documentation: Techniques for documenting findings and preparing security reports. Best practices for writing effective reports.

Legal and Ethical Issues: Legal frameworks and ethical considerations in ethical hacking. Understanding laws and regulations related to hacking.

Text Books:

1. Ethical Hacking and Penetration Testing Guide, Rafay Baloch, Packt Publishing, Latest Edition.
2. The Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley, Latest Edition.
3. Hacking: The Art of Exploitation, Jon Erickson, No Starch Press, Latest Edition.
4. Network Security Essentials, William Stallings, Pearson, Latest Edition.

Reference Books:

1. Metasploit: The Penetration Tester’s Guide, David Kennedy, Jim O’Gorman, Devon Kearns, Mati Aharoni, No Starch Press, Latest Edition.
2. Hands-On Ethical Hacking and Network Defense, Michael T. Simpson, David Kim, Cengage Learning, Latest Edition.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_cs94/preview

Course Title	APPLIED MACHINE LEARNING IN PYTHON				B.Tech. AI&ML V Sem (Honours Degree)		
Course Code	Hours / Week			Credits	Maximum Marks		
20923901	L	T	P	C	Continuous Internal Assessment	End Exams	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				End Exam Duration: 3Hrs			

Course Objectives:

- Understand the Machine Learning Basic concepts.
- Understand the need of python in machine learning.
- To Analyse Supervised Learning Algorithms.

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

CO1	Students will be able to identify the difference between a supervised (classification) and unsupervised (clustering) technique
CO2	Understand Supervised Learning Algorithms.
CO3	Identify which technique they need to apply for a particular dataset and need, engineer features to meet that need, and write python code to carry out an analysis.

UNIT-I

Machine learning basics: The need for Machine learning, understanding machine learning, machine learning methods, Supervised learning, Un supervised learning, semi supervised learning, reinforcement learning.

UNIT-II

The Python Machine Learning Ecosystem: Python Introduction, strengths, pitfalls, setting up a python Environment, Why Python for Data science.

Introducing the Python Machine Learning Ecosystem: Jupiter notebooks, Numpy, Pandas.

UNIT-III

Processing, Wrangling and Visualizing data: Data collection, Data description, Data Wrangling, data Summarization, Data Visualization.

UNIT-IV

Machine Learning Algorithms: Introduction to Classification, **Logistic Regression**: Introduction, Types of Logistic Regression, Binary Logistic regression Model, Multinomial Logistic regression Model, **Support vector machine:** Introduction to SVM, Pros and Cons of SVM classifier.

UNIT-V

Classification Algorithms: Decision Tree, Naïve-Bayes, Random Forest.

Case studies: Analyzing Bike sharing Trends.

Text Books:

1. Practical Machine Learning with Python- A problem solver's Guide to Building Real world intelligent Systems, Dipanjan Sarkar, Raghav Bali, Tushar Sharma. Apress publications.
2. Introduction to Machine Learning with Python- A Guide for Data Scientists, Andreas C.Miiller and sarah Guido, O'REILLY publications.

Reference Books:

1. Machine Learning with Python tutorials point.www.tutorialspoint.com

Course Title	INTELLIGENT AGENTS				B.Tech. AI&ML V Sem (Honours Degree)		
Course Code	Hours / Week			Credits	Maximum Marks		
20923902	L	T	P	C	Continuous Internal Assessment	End Exams	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				End Exam Duration: 3Hrs			

Course Objectives:

- Determine the fundamental concepts, depictions, and processes for Designing.
- Improve reinforcement learning model for real world problems.
- Get to use of language models for various NLP tasks.
- Model Agent's contributions awareness and preprocessing practices.
- Create and execute machine hardware and software.

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

CO1	Demonstrate the basic concepts, representations, and algorithms for Planning.
CO2	Develop reinforcement learning model for real world problems.
CO3	Make use of language models for various NLP tasks.
CO4	Model Agent's inputs perception and preprocessing techniques.
CO5	Design and implement robot hardware and software.

UNIT I

Intelligent Agents: Agents and environments, good behavior: The concept of rationality, The nature of environments, The structure of agents.

UNIT II

Classical Planning: Definitions, Algorithms, Planning graphs, Classical planning approaches, Analysis. PLANNING AND ACTING IN THE REAL WORLD – Time, schedule and resources, Hierarchical planning, Planning, and acting in nondeterministic domains, Multiagent planning.

UNIT III

Knowledge Representation: Ontological engineering, Categories and objects, Events, Mental events and mental objects, Reasoning systems for categories, Reasoning with default information, The Internet shopping world.

UNIT IV

Reinforcement Learning And NPL: Introduction, Passive and active reinforcement learning, Generalization in reinforcement learning, Policy search, Applications of reinforcement learning. **NPL**: Language models, Text classification, Information retrieval, Information extraction

UNIT V

Natural Language for Communication, Perception, Robotics: Phrase structure grammars, syntactic analysis, Augmented grammars and semantic interpretation, Machine translation, Speech recognition.

Perception – Image formation, Early image processing operations, Object recognition by appearance, Reconstructing the 3D world, Object recognition from structural information, Using vision.

Robotics – Introduction, Robot hardware, Robotic perception, planning to move, Planning uncertain movements, Moving, Robotic software architectures, Application domains

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence -A Modern Approach", 2/e, Pearson, 2003.
2. Nils J Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann Publications, 2000.

Reference Books:

1. An Introduction to Multiagent Systems (first edition) by Michael Wooldridge. ISBN 0-471-49691-X.
2. A Modern Approach, Second Edition by Stuart Russell and Peter Norvig. ISBN 0-13-790395- 2 (especially recommended for students who have not taken CSE 327 at Lehigh).

Course Title	BUSINESS INTELLIGENCE				B.Tech. AI&ML VI Sem (Honours Degree)		
Course Code	Hours / Week			Credits	Maximum Marks		
20923903	L	T	P	C	Continuous Internal Assessment	End Exams	Total
	4	0	0	4	40	60	100
Mid Exam Duration: 90 Minutes				End Exam Duration: 3Hrs			

Course Objectives:

- Introduce the concepts and components of Business Intelligence (BI)
- Evaluate the technologies that make up BI (data warehousing, OLAP)
- Define how BI will help an organization and whether it will help yours
- Identify the technological architecture that makes up BI systems
- Plan the implementation of a BI system

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

CO1	Understand the essentials of BI & data analytics and the corresponding terminologies.
CO2	Analyze the steps involved in the BI - Analytics process.
CO3	Illustrate competently on the topic of analytics.
CO4	Understand & Implement the K-Means Clustering with Iris Dataset.
CO5	Demonstrate the real time scenario (Case study) by using BI & Analytics techniques

UNIT - I

Introduction: Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.

UNIT - II

BI – Data Mining & Warehousing: Data Mining - Introduction to Data Mining, Architecture of Data Mining and How Data mining works (Process) , Functionalities & Classifications of Data Mining, Representation of Input Data, Analysis Methodologies. Data Warehousing - Introduction to Data Warehousing, Data Mart, Online Analytical Processing (OLAP) – Tools, Data Modelling, Difference between OLAP and OLTP, Schema – Star and Snowflake Schemas, ETL Process – Role of ETL

UNIT - III

BI – Data Preparation: Data Validation - Introduction to Data Validation, Data Transformation – Standardization and Feature Extraction, Data Reduction – Sampling, Selection, PCA, Data Discretization.

UNIT - IV

BI – Data Analytics Process: Analytics Process - Introduction to analytics process, Types of Analytical Techniques in BI – Descriptive, Predictive, Perspective, Social Media Analytics, Behavioral, Iris Datasets.

UNIT - V

Implementation of BI – Analytics Process: Operational Intelligence: Technological – Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis.

Text Books:

1. Carlo-Vercellis, "Business Intelligence Data Mining and Optimization for Decision-Making", First Edition.
2. Drew Bentely, "Business Intelligence and Analytics" ,@2017 Library Pres., ISBN: 978-1- 9789- 2136-8.

Reference Books:

1. Larissa T. Moss & Shaku Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications", First Edition, Addison-Wesley Professional,2003

Course Title	DESIGN PATTERNS				B.Tech. AI&ML VI Sem (Honours Degree)			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
20923904	PEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	30	70	100
Mid Exam Duration: 2 Hours					End Exam Duration: 3Hrs			

Course Objectives:

- To understand design patterns and their underlying object oriented concepts.
- To understand implementation of design patterns and providing solutions to real world software design problems.
- To understand patterns with each other and understanding the consequences of combining patterns on the overall quality of a system.

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

CO1	Know the underlying object oriented principles of design patterns.
CO2	Understand the context in which the pattern can be applied.
CO3	Understand how the application of a pattern affects the system quality and itstradeoffs.

UNIT - I

Introduction to Design Patterns: Design Pattern Definition, Design Patterns in Small Talk MVC, Describing Design Patterns, Catalog of Design Patterns, Organizing the Catalog, Solving of Design Problems using Design Patterns, Selection of a Design Pattern, Use of Design Patterns.

UNIT - II

Designing A Document Editor: A Case Study: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look and Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation. Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

UNIT - III

Structural Patterns-1: Adapter, Bridge, Composite. Structural Patterns-2: Decorator, Façade, Flyweight, Proxy, Discuss of Structural Patterns.

UNIT - IV

Behavioral Patterns-1: Chain of Responsibility, Command, Interpreter, Iterator. Behavioral Patterns-2: Mediator, Memento, Observer.

UNIT - V

Behavioral Patterns-2 (cont'd): State, Strategy, Template Method, Visitor, and Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern

Community, An Invitation, A Parting Thought.

Text Books:

1. Design Patterns by Erich Gamma, Pearson Education.
2. Pattern's in JAVA Vol-I By Mark Grand, Wiley DreamTech.
3. Pattern's in JAVA Vol-II By Mark Grand, Wiley DreamTech.
4. JAVA Enterprise Design Patterns Vol-III By Mark Grand, Wiley DreamTech

Reference Books:

1. Head First Design Patterns By Eric Freeman-Oreilly-spd
2. Design Patterns Explained By Alan Shalloway, Pearson Education.
3. Pattern Oriented Software Architecture, F.Buschmann &others, John Wiley & Sons.