

BIJUPATNAIKUNIVERSITY OF TECHNOLOGY, ODISHA
ROURKELA



Curriculum and Syllabus

B. Tech (*MechanicalEngineering*)from the Admission Batch
2018-19

Semester (7th)

Seventh Semester							
Theory							
Sl No	Category	Course Code	Course Title	L-T-P	Credit	University Marks	Internal Evaluation
1	HS	RED7E001	Entrepreneurship Development	3-0-0	3	100	50
2	PE	RME7D001	Power Plant Engineering	3-0-0	3	100	50
		RME7D002	Product Design and Production Tooling (PDPT)				
		RME7D003	Design of Machine Components				
3	PE	RME7D004	Mechanical Vibration	3-0-0	3	100	50
		RME7D005	Refrigeration and Air Conditioning				
		RME7D006	Micro and Nano Machining				
4	OE	REI6D001	Micro Electronic Mechanical Systems	3-0-0	3	100	50
		REC5D006	Digital VLSI Design				
		REC7D002	Embedded Systems				
5	OE	REV5D004	Disaster Management	3-0-0	3	100	50
		RIP7E002	Intellectual Property Right				
		RGT6A003	Green Technology				
6	OE	RIT7D001	Internet of Things	3-0-0	3	100	50
		RIS7B001	Industrial Safety Engineering				
		RCS7D007	Soft Computing				
7	MC*	RIK7F001	Essence of Indian Knowledge Tradition - II	3-0-0	0		100 (Pass Mark is 37)
Total Credit (Theory)					18		
Total Marks						600	300
Practical							
1	PSI	RMP7H201	Minor Project	0-0-6	3		200
2	PSI	RSM7H202	Seminar - II	0-0-3	1		100
3	PSI	RCV7H203	Comprehensive Viva	0-0-3	1		100
Total Credit (Practical)					5		
Total Semester Credit					23		
Total Marks							400

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus, the grade obtained will not be affecting the grade point average. However, it shall appear on the grade sheet as per AICTE rule.**

7 th Semester	RED7E001	Entrepreneurship Development	L-T-P 3-0-0	3 Credits
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Module I:**(10 hours)**

Entrepreneurship: Concept of entrepreneurship and intrapreneurship, Types of Entrepreneurs, Nature and Importance, Entrepreneurial Traits and Skills, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality

Module II:**(8 hours)**

Entrepreneurial Environment, Identification of Opportunities, Converting Business Opportunities into reality. Start-ups and business incubation, Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Environmental pollution Act, Industrial Policies and Regulations

Module III:**(10 hours)**

Need to know about Accounting, Working capital Management, Marketing Management, Human Resources Management, and Labour Laws. Organizational support services - Central and State Government, Incentives and Subsidies.

Module IV:**(12 hours)**

Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Governments in reviving industries.

Books:

- [1] Entrepreneurship Development and Management, Vasant Desai, HPH
- [2] Entrepreneurship Management, Bholanath Dutta, Excel Books
- [3] Entrepreneurial Development, Sangeeta Sharma, PHI
- [4] Entrepreneurship, Rajeev Roy, Oxford University Press

Digital Learning Resources:

Course Name: Entrepreneurship
 Course Link: <https://nptel.ac.in/courses/110/106/110106141/>
 Course Instructor: Prof. C Bhaktavatsala Rao, IIT Roorkee

Course Name: Entrepreneurship Essentials
 Course Link: <https://nptel.ac.in/courses/127/105/127105007/>
 Course Instructor: Prof. Manoj Kumar Mondal, IIT Kharagpur

Module I:**(10 hours)****1. INTRODUCTION**

Different sources (Conventional and non-conventional) of energy and the principle of power generation only, Types of power plant and site selection, overall view of a steam power plant.

2. STEAM GENERATOR

Fossil fuel steam generators, classification, circulation in water tube boilers, Modern high pressure water tube boilers (both sub critical and super critical), Boiler mounting and accessories, Combustion equipment: air supply systems (Natural and Mechanical Draught Systems). Pulverized coal burning systems and Basics of Fluidized bed combustion, Feed water treatment (Necessity & general consideration only). Boiler performance calculations.

Module II:**(8 hours)****3. FLOW THROUGH NOZZLES**

Types of nozzles and their area of application & related calculation, critical pressure & choked flow, super saturated flow. Effect of friction and nozzle efficiency

4. STEAM TURBINES

Turbine types, Variation of Pressure and Velocity in different types of turbines, Simple impulse Turbines, Flow through turbine blades and velocity diagram, Pressure - compounded impulse turbines and Velocity compounded impulse turbines. Turbine power and related calculations.

Module III:**(10 hours)****5. REACTION TURBINES**

Reaction turbines Flow through blades and velocity diagram, degrees of reaction, Parsons turbine, power and related calculations, Blade height calculations, Losses in steam turbines, Reheat factor & condition line, Governing of turbines.

6. STEAM CONDENSER & CIRCULATING WATER SYSTEMS

Types, Surface condenser, Performance calculation, Air removal methods, Vacuum & vacuum efficiency. Cooling towers. (types, principle of operation and performance)

Module IV:**(8 hours)****7. NUCLEAR POWER PLANT**

Introduction, Nuclear fuels, Nuclear fission, Reactor components, & materials and classification,, Boiling Water Reactor (BWR), Pressurized water Reactor (PWR), CANDU Reactor, Gas cooled Reactors, Liquid metal fast breeder Reactor. Heavy water Reactors. Waste disposal and Safety of Nuclear power plant

8. ECONOMICS OF POWER PLANT

Basic definitions, cost of electrical energy (Fixed cost and operating cost), Types of tariff, Types of loads (typical load curves), Economic Load sharing

Books:

1. Power plant Engineering ; - By P.K. Nag (2nd edition) TMH
2. Power Plant Engineering by Arora and Domkundwar, Dhanpat Rai publications
3. Power Plant Engineering by Yadav
4. Power Plant Engineering by Rajput
5. Power plant Technology : By E.I. Wakil TMH
6. Power Plant Engineering by C.Elanchezhian, Sarvanakumar, Vijayramnath, IK International Publishing House Pvt Ltd.

7th Semester	RME7D002	Production Design and Power Plant Engineering Production Tooling	L-T-P 3-0-0	3 Credits
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Module I:**(12 Hours)**

Product Design-Product design considerations, product planning, product development, value analysis, product specification. Role of computer in product design.

Process Planning – selection of processes, machines and tools. Design of sequence of operations, Time & cost estimation

Module II:**(12 Hours)**

Forging design- allowances, die design for drop forging, design of flash and gutter, upset forging die design.

Sheet metal working- Design consideration for shearing, blanking piercing, deep drawing operation, Die design for sheet metal operations, progressive and compound die, strippers, stops, strip layout.

Module III:**(12 Hours)**

Design of jigs and fixtures, principle of location and clamping, clamping methods, locating methods, Drill Jig bushing, Indexing type drilling Jig.

Design of single point cutting tool, broach and form tool. Tooling design for turret lathe and automats. Design of limit gauges.

Books:

- [1] Product Design & Manufacturing, A K Chitale, R C Gupta, Eastern Economy Edition, PHI.
- [2] Product Design & Development, Karl T Ulrich, Steven D Eppinger, Anita Goyal, McGraw Hill.
- [3] A Textbook of Production Engineering, P.C. Sharma, S. Chand & Co
- [4] Fundamentals of Tool Engineering design, S.K. Basu, S.N. Mukherjee, R. Mishra, Oxford & IBH Publishing Co.
- [5] Technology of Machine Tools, Krar, Gill, Smid, Tata Mc Graw Hill
- [6] Jigs & Fixture Design, Edward G Hoffman, Cengage Learning.

7th Semester	RME7D003	Design of Machine Components	L-T-P 3-0-0	3 Credits
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Module-I: (10 hours)

Design of Pressure vessels: Thin pressure vessels: cylindrical and spherical vessels, Design of end Closures, Thick cylindrical shells.

Design of Lever: Classification, Design of levers, Cranked lever, Lever of safety - valve.

Module-II: (10 hours)

Design of belt drive and power screw: Design of belt drive and pulley, Power screw design with square thread such as screw jack.

Design of clutch and brake: Friction clutch, Cone clutch and Centrifugal clutch, Block brake, Band brake, Internal expanding shoe brake.

Module-III: (10 hours)

Gears: Design of Spur, Helical, bevel and worm gears. **Flywheel:** Design of Flywheel.

Module-IV: (12 hours)

Design of I.C. Engine components: Design of Cylinder, Piston, Connecting Rod, Crank Shaft.

Introduction to Finite Element Method: FEM fundamental concepts, Procedure of FEM, Finite Element Modeling of one-dimensional problems. Finite Element Analysis of 2-D problems: Shape function, Strain Displacement Relation, Element Characteristics Matrix.

Books:

- [1] Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
- [2] Design of Machine Elements by C. S. Sharma and K. Purohit, PHI
- [3] Mechanical Engineering Design, J.E. Shigley, C.R. Mischke, R.G. Budynas and K.J. Nisbett, TMH
- [4] Machine Design, P. Kanaiah, Sciotech Publications
- [5] Fundamentals of Machine Component Design by R.C. Juvinall and K.M. Marshek, John Wiley & Sons
- [6] Machine Drawing by N. Sidheswar, McGraw-Hill
- [7] Machine Design, P.C. Sharma and D.K. Agrawal, S.K. Kataria & Sons
- [8] Machine Design, Pandya and Shah, Charotar Book Stall
- [9] Machine Design, Robert L. Norton, Pearson Education Asia.

7 th Semester	RME7D004	Mechanical Vibration	L-T-P 3-0-0	3 Credits
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Design Hand Book:

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
4. Design Data Hand Book by K.Mahadevan and B.Reddy,CBS Publishers

Module I:**(12 Hours)****INTRODUCTION & IMPORTANCE OF MECHANICAL VIBRATION:**

Brief history of Mechanical Vibration, Types of Vibration, Simple Harmonic Motion (S.H.M.), Principle of superposition applied to S.H.M., Beats, Fourier Analysis, Concept of degree of freedom for different vibrating systems.

UNDAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Modeling of Vibrating Systems, Evaluation of natural frequency – differential equation, Energy & Rayleigh's methods, Equivalent systems.

DAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Different types of damping, Equivalent viscous damping, structural damping, Evaluation of damping using free and forced Vibration technique, Concept of critical damping and its importance, study of vibration response of viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement.

Module II:**(12 Hours)**

FORCED VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Steady state solution with viscous damping due to harmonic force, reciprocating and rotating unbalance mass, vibration isolation and transmissibility due to harmonic force excitation and support motion. Vibration measuring instruments – vibrometer and accelerometer. Whirling of shaft with single disc and without damping, Concept of critical speed and its effect on the rotating shaft.

UNDAMPED VIBRATION OF TWO DEGREE FREEDOM SYSTEMS: Free vibration of spring coupled and mass coupled systems, Longitudinal, Torsional and transverse vibration of two degree freedom systems, influence coefficient technique, Un-damped vibration Absorber.

Module III:**(12 Hours)**

INTRODUCTION TO MULTI-DEGREE FREEDOM SYSTEMS: Normal mode vibration, Co-ordinate coupling-close coupled and far coupled systems, Orthogonality of mode shapes, Methods of matrix iteration, Holzer's method and Stodola method. Torsional vibration of two, three and multi-rotor systems. Dunkerley's lower bound approximate method.

CONTINUOUS SYSTEMS: Vibration of strings, longitudinal vibration of rods, torsional vibration of rods, transverse vibration of Euler-beams.

Books:

- [1] Theory of vibration with Applications: W.T. Thomson and Marie Dillon Dahleh,

7th Semester	RME7D005	Refrigeration and Air conditioning	L-T-P 3-0-0	3 Credits
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Pearson

Education 5th ed. 2007.

- [2] Introductory Course on theory and Practice of Mechanical Vibrations. J.S. Rao & K. Gupta,
New Age International Publication, New Delhi, 2007.
- [3] Mechanical Vibrations: S.S. Rao, Prarson Education Inc, 4th ed. 2003.
- [4] Mechanical Vibrations: S. Graham Kelly, Schaum's outline series, Tata McGraw Hill, Special Indian ed., 2007
- [5] Mechanical Vibrations: V.P. Singh, Dhanpat Rai & company Pvt. Ltd. 3rd ed., 2006
- [6] Elements of vibration Analysis: Leonard Meirovitch, Tata McGraw Hill, Special Indian ed.,2007

Module-I:

(12 Hours)

Air Refrigeration System : Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Air-craft with problems.

Vapour Compression System : Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, sub-cooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution.

Multi-stage compression and Multi-evaporator systems : Different arrangements of compressors and inter-cooling, Multistage compression with inter-cooling, Multi evaporator system, Dual compression system. Simple problems

Module-II:

(12 Hours)

Vapour Absorption System : Simple Ammonia - absorption system, Improved absorption system, Analysis of vapour absorption system (Specifically of analyzing column and rectifier), Electrolux / Three fluid system, Lithium-bromide-water vapour absorption system, comparison of absorption system with vapour compression system. Simple Problems and solution.

Thermoelectric Refrigeration: Basics and Principle. Defining the figure of Merit. (No Problem) **Refrigerants:** Classification of refrigerants and its designations- Halocarbon (compounds, Hydrocarbons, Inorganic compounds, Azeotropes, Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Brines. Alternative refrigerants (Organic and inorganic compounds).

Module-III:

(12 Hours)

Psychrometrics : Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, Dehumidification, Mixture of air streams. Review question and discussions

Requirements of comfort air conditioning: Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart, effective temperature, factors governing optimum effective temperature

Air Conditioning System: Process in air conditioning : Summer air conditioning, Winter air conditioning and year round air conditioning, Cooling load calculations. Review question and discussions.

7th Semester	RME7D006	Micro and Nano Machining	L-T-P 3-0-0	3 Credits
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Books:

- [1] Refrigeration and Air Conditioning by R.C. Arora , PHI Publication
- [2] Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill.
- [3] Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons. (Chapters; 3,4,5,6,7,11,16,17,19,20)
- [4] Refrigeration and Airconditioning Data book by Manohar Prasad
- [5] Refrigeration and Air conditioning by P.L. Ballney, Khanna Publishers.
- [6] Refrigeration and Air conditioning by Manohar Prasad, New Age international publishers

Module-I:**(12 hours)****Introduction**

Introduction, Basic elements of molecular dynamics modelling, Design and requirements for state-of-the-art MD cutting process simulations, Capabilities of MD for nanoscale material removal process analysis, Advances and recent developments in material removal process simulation, Summary.

Ductile Mode Cutting of Brittle Materials

The mechanism of ductile mode cutting of brittle materials, The chip formation in cutting of brittle materials, Machined surfaces in relation to chip formation mode

Diamond Tools in Micromachining

Diamond technology, Preparation of substrate, Modified HFCVD process, Nucleation and diamond growth, Deposition on complex substrates, Diamond micromachining.

Module-II: (8 hours)**Conventional Processes: Micro-turning, Micro-drilling and Micro-milling**

Introduction, Micro-turning, Micro-drilling, Micro-milling, Product quality in micromachining

Micro-grinding and Ultra-precision Processes

Introduction, Micro and nanogrinding, Nanogrinding tools

Module-III:**(8 hours)****Non-Conventional Processes: Laser Micromachining**

Introduction, Fundamentals of lasers, Laser microfabrication, Laser nanofabrication.

Evaluation of Subsurface Damage in Nano and Micromachining

Destructive evaluation technologies, Non-destructive evaluation technologies

Module-IV:**(10 hours)****Micro and Nano Finishing Processes**

Need for Nano finishing, Magnetic abrasive Finishing, Magnetorheological Finish, Elastic Emission Finishing, Magnetic Float Polishing, Ion Beam finishing.

Micro Joining

6th Semester	REI6D001	Micro Electronics Mechanical Systems	L-T-P 3-0-0	3 Credits
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Challenges, Micro Resistance welding, Ultrasonic welding, Micro TIG, Applications.

Applications of Nano and Micromachining in Industry

Typical machining methods, Applications in optical manufacturing, Semiconductor and electronics related applications.

Books:

- [1] J. Paulo Davim, Mark J. Jackson Nano and Micromachining, John Wiley & Sons, 2013
- [2] Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
- [3] Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
- [4] Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
- [5] V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012.
- [6] Yi Qin, Micro-manufacturing Engineering and Technology, William Andrew, 2015

Module-I:

(12 hours)

Introduction and Emergence of MEMS, Scaling issues, materials for MEMS, Thin film deposition, Photolithography, doping, wet and dry etching
Micromachining Techniques: Surface and Bulk micro machining, wafer bonding, surface micro machining and LIGA process, Silicon as material for micromachining, (Chapter 3 and Section 8.2 of Book 1, Chapter 2 of Book 2)

Module-II: (12 hours)

MEMS devices, Engineering Mechanics for Micro System Modeling and Design – static bending of thin plates, Mechanical vibrational analysis, Thermo mechanical analysis, fracture mechanics analysis, thin film mechanics, Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage, Theory and design: Micro Pressure Sensor, micro accelerometer – capacitive and piezoresistive, micro actuator. (Section 4.1 to 4.3 and 6.2.2 of Book 1, Section 3.4 of Book 2)

Module-III:

(12 hours)

MEMS Applications: Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Optical Gyroscopes: Micro-lens, Micro-mirror, Optical Switch
Radiofrequency MEMS: Inductor, Varactor, Filter, Resonator.
Microfluidics: Capillary action, Micro pumping, Electro wetting, Lab-on-a-chip.
Electronic interfaces, design, simulation and layout of MEMS devices using CAD tools. (Section 10.1 to 10.8 of Book 2)

Books:

- [1] G.K. Ananthuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.
- [2] N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.
- [3] T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.

7th Semester	REC5D006	Digital VLSI Design	L-T-P 3-0-0	3 Credits
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[4] Gabriel M. Rebeiz: RF MEMS Theory, design &Technology, Wiley India Education,2010.

Digital Learning Resources:

Course Name: MEMS and Microsystems
 Course Link: <https://nptel.ac.in/courses/117/105/117105082/>

MODULE-I

(08Hours)

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.

MODULE-II

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion NMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

MODULE-III

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage

Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

MODULE-IV

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring IDDQ Test.

MODULE-V

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, FlashMemory.

Books:

- [1] *CMOS Digital Integrated Circuits: Analysis and Design*, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.
- [2] *Principles of CMOS VLSI Design – a Systems Perspective*, K. Eshraghian and N.H.E. Weste, Addison Wesley, 2nd Edition, 1993.
- [3] *Digital Integrated Circuits– A Design Perspective*, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, PHI, 2nd Edn.

- [4] Modern VLSI Design System – *on – Chip Design*, Wayne Wolf, PHI, 3rd Edn.
- [5] VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010.
- [6] CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.
- [7] Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.
- [8] VLSI Design Technique for Analog and Digital Circuits, R L Geiger, TMH.

Digital Learning Resources:

Course Name: VLSI Design
Course Link: <https://nptel.ac.in/courses/117/101/117101058/>
Course Instructor: Prof. A.N. Chandorkar, IIT Bombay

Course Name: Digital VLSI Testing
Course Link: <https://nptel.ac.in/courses/117/105/117105137/>
Course Instructor: Prof. S, Chattopadhyay, IIT Kharagpur

Course Name: VLSI Technology
Course Link: <https://nptel.ac.in/courses/117/106/117106093/>
Course Instructor: Dr. Nandita Dasgupta, IIT Madras

7 th Semester	REC7D002	Embedded Systems	L-T-P 3-0-0	3 CREDITS
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Module-I**(12 hrs)**

Hardware Concepts Embedded System: Application and characteristics of embedded systems, Overview of Processors and hardware units in embedded system, embedded software in a system, Examples of Embedded system.

ARM:ARM pipeline, Instruction Set Architecture ISA: Registers, Data Processing Instructions, Data Transfer Instructions, Multiplication's instructions, Software interrupt, Conditional execution, branch instruction, Swap instruction, THUMB instructions.

Module-II**(8hrs)**

Devices and device drivers: I/O devices, Serial peripheral interfaces,IIC, RS232C, RS422, RS485, Universal serial bus, USB Interface, USB Connector IrDA, CAN, Bluetooth, ISA, PCI, PCI -X and advance busses, Device drivers.

Module –III**(9 hrs)**

Real Time Operating System (RTOS): Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA)

Module –IV**(8 hrs)**

Modelling Techniques: Software and programming concept: Processor selection for an embedded system, State chart, SDL, Petri-Nets, Unified Modeling Language (UML). Hardware software codesign. Hardware and software partitioning: K-L partitioning, Partitioning using genetic algorithm,

Module –V**(8 hrs)**

Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management. Software design for low power devices.

Books:

- [1] “Embedded system architecture, programming and design” By Raj Kamal, TMH.
- [2] “Embedded System Design” by SantanuChattopadhyay, PHI
- [3] Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware /Software Introduction, John Wiley, 2002.
- [4] “Hardware software co-design of Embedded systems” By Ralf Niemann, Kulwer Academic.
- [5] “Embedded real time system programming” By Sriram V Iyer, Pankaj Gupta, TMH.

Digital Learning Resources:

Course Name: Embedded Systems
Course Link: <https://nptel.ac.in/courses/108/102/108102045/>
Course Instructor: Prof. Santanu Chaudhary, IIT Delhi

Course Name: Embedded Systems
Course Link: <https://nptel.ac.in/courses/108/105/108105057/>
Course Instructor: Prof. Amit Patra et al, IIT Kharagpur

Course Name: Embedded Systems Design
Course Link: <https://nptel.ac.in/courses/106/105/106105159/>
Course Instructor: Prof. Anupam Basu, IIT Kharagpur

7 th Semester	REV5D004	Disaster Management	L-T-P 3-0-0	3 CREDITS
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Module I (12 hr)

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

Module II (6 hr)

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

Module III (6 hr)

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

Module IV (12 hr)

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

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

Books

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India

<http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf>

7th Semester	RIP7E002	Intellectual Property Right	L-T-P 3-0-0	3 CREDITS
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MODULE-I (12 Hours)

Introduction: Intellectual property: meaning, nature and significance, need for intellectual property Right (IPR), IPR in India – Genesis and development, IPR in abroad, Examples: - Biotechnology Research and Intellectual Property Rights Management. What is a patent, what can be protected by a patent, why should I apply for a patent? Patent Law, Patentability requirements, non-Patentable subject matters, Layout of the Patents. Procedure for domestic and international filing of applications, Restoration, Surrender and Revocations of Patents, Rights of Patentee and Working of Patent, Licensing and Enforcing Intellectual Property.

MODULE-II (10 Hours)

Copyrights: Copyright: meaning, scope; What is covered by copyright? How long does copyright last? Why protects copyright? Related rights, Rights covered by copyright. Ownership: Duration, Division, Transfer and Termination of Transfers.

MODULE-III (10 Hours)

Infringement and Remedies: Literal and non-literal infringement, Role of claims, Doctrines on infringement: Equivalent doctrine, Pith and Marrow doctrine, Comparative test. Defences: Gillette Defence, General grounds, Patents granted with conditions, Parallel import. Remedies: Civil, Administrative.

MODULE-IV (08 Hours)

State Law: Trade Secret, Contract, Misappropriation, Right of Publicity Trademarks, Trade Secret - Overview, Requirements, Misappropriation of Trade Secret, Departing Employees, Remedies, Criminal Liability, Misappropriation, Clickwrap Agreements, Idea Submissions; Right of Publicity, Federal Pre-emption, Review.

Books:

- [1] W. R. Cornish and D. Llewellyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights, Sweet & Maxwell.
- [2] Lionel Bently and Brad Sherman, Intellectual Property Law, Oxford University Press.
- [3] P. Narayanan, Intellectual Property Law, Eastern Law House
- [4] B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
- [5] V. K. Ahuja, Law Relating to Intellectual Property Rights, LexisNexis
- [6] AjitParulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications;Macmillan India ltd, 2006
- [7] P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.

Reference:

- [1] The Copyright Act, 1957
- [2] The Patent Act, 1970
- [3] The Trade Marks Act, 1999
- [4] The Designs Act, 2000
- [5] The Geographical Indication of Goods Act, 1999
- [6] The Protection of Plant Varieties and Farmers' Rights Act, 2001
- [7] The Semiconductor Integrated Circuits Layout Design Act, 2000

Digital Learning Resources:

Course Name: [Intellectual Property](#)

Course Link: <https://nptel.ac.in/courses/109/106/109106137/>

Course Instructor: Prof. Feroze Ali, IIT Madras

7th Semester	RGT6A003	Green Technology	L-T-P 3-0-0	3 CREDITS
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Module I: (12 Hrs)

Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact. Planning for the Future to reduce global warming:- Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.

Module II: (8 Hrs)

Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India —More Forests, Less Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India. Green Technologies for Energy Production: - Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.

Module III: (10 Hrs)

Green Technologies for Personal and Citywide Application: - Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports. Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC), Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbours, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects, 'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.

Module IV: (10 Hrs)

Some High-tech Measures for Reducing Carbon Emissions: - Use of Solar Power with Satellite-Based Systems, Use of Carbon Capture and Storage (Sequestration), Microorganisms, A Quick SWOT Analysis. Recommended Plan of Action: - India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, few case studies on Projects undertaken by Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

Books

- [1] Green Technologies, Soli J. Arceivala, McGraw Hill Education
- [2] Green Technologies and Environmental Sustainability edited by Ritu Singh, Sanjeev

Kumar

Digital Learning Resources:

Course Name: Sustainable Materials and Green Buildings

Course Link:<https://nptel.ac.in/courses/105/102/105102195/>

Course Instructor:Dr. B. Bhattacharjee, IIT Delhi

7th Semester	RIT7D001	Internet of Things	L-T-P 3-0-0	3 CREDITS
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Module-1

Introduction-Definition & Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.

Module-2**Domain Specific IoTs**

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response,

Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection , River Floods Detection , **Energy**- Smart Grids , Renewable Energy Systems , Prognostics , Retail-Inventory Management , Smart Payments , Smart Vending Machines , **Logistics**-Route Generation & Scheduling , Fleet Tracking , Shipment Monitoring , Remote Vehicle Diagnostics, **Agriculture**-Smart Irrigation ,Green House Control ,**Industry** -Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,Health & Lifestyle -Health & Fitness Monitoring, Wearable Electronics

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking , Network Function Virtualization

Module-3**IoT Platforms Design Methodology**

IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification , Service Specifications , IoT Level Specification, Functional View Specification , Operational View Specification , Device & Component Integration , Application Development, Case Study on IoT System for Weather Monitoring, Motivation for Using Python

IoT Physical Devices & Endpoints

What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices- pcDuino, Beagle Bone Black , Cubieboard

Module-3

IoT & Beyond : Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID, Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and dataintensive IoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet Of Everything

Books:

1. Internet of Things, A Hands on Approach, by ArshdeepBahga& Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson

7 th Semester	RIS7B001	Industrial Safety Engineering	L-T-P 3-0-0	3 CREDITS
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Module-I:**(7 hours)**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Module-II**(7 hours)**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module-III:(7 hours)

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module-IV:**(7 hours)**

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of faultfinding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module-V:**(8 hours)**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

7th Semester	RCS7D007	Soft Computing	L-T-P 3-0-0	3 CREDITS
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Module I: (14 Hrs)

Basic tools of soft Computing: Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non - linear Error surface and optimization

Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets; Basic set operations; Fuzzy relations, Composition of Fuzzy relations, Fuzzy inference, Zadeh's compositional rule of inference; Defuzzification; Fuzzy logic control; Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.

Module II: (14 Hrs)

Neural networks: Single layer networks, Perceptron; Activation functions; Adaline- its training and capabilities, weights learning, Multilayer perceptrons; error back propagation, generalized delta rule; Radial basis function networks and least square training algorithm, Kohonen self - organizing map and learning vector quantization networks; Recurrent neural networks, Simulated annealing neural networks; Adaptive neuro-fuzzy information; systems (ANFIS).

Module III: (8 Hrs)

Evolutionary Computing: Genetic algorithms: Basic concepts, encoding, fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic, basic evolutionary programming concepts Applications, hybrid evolutionary algorithms.

Books:

1. F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design - Theory, Tools and Applications". Pearson Education.(Printed in India).
2. J. S. R. Jang. C. T. Sun and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.
3. Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.
4. S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India. 4) V. Keeman, "Learning and Soft computing", Pearson Education, India.
5. R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).

7th Semester		Essence of Indian Knowledge Tradition - II	L-T-P 3-0-0	3 CREDITS
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Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes :

At the end of the Course, Student will be able to:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. Illustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

Module-1:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module-2:

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Module-3:

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module-4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module-5:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their

food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
3. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino.

Digital Learning Resources:

Course Name:	Ayurvedic Inheritance of India
Course Link:	https://nptel.ac.in/courses/121/106/121106003/
Course Instructor:	Dr M. S. Valiathan, IIT, Madras

<https://www.youtube.com/watch?v=LZP1StpYEPM>