# HANDBOOK

## COURSE STRUCTURE AND DETAILED SYLLABUS

## B. Tech
## (Batch: 2016-20)


## INSTITUTE OF ENGINEERING AND TECHNOLOGY
# JK LAKSHMIPAT UNIVERSITY
Near Mahindra SEZ, Mahapura, Ajmer Road, Jaipur 302 026
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## Program Education Objectives

The B.Tech. Programs at IET, JKLU are designed to prepare students for continued learning and successful careers. Our alumni are expected to:

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice.

PEO2: Continue their intellectual development through critical thinking, self- study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks.

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related

issues. PEO5: Embrace roles of team members and leaders

in their career.

## Program Outcomes

The graduates of B.Tech Programs at IET, JKLU will have following competencies:

*PO 1: Life-long learning:* Demonstrate inquisitiveness, open mindedness, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO 2: Citizenship, Sustainability, and Professional ethics

PO 2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

PO 2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to the professional engineering practice.

PO 2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO 3: Engineering knowledge and Modern tool usage

PO 3a: Demonstrate clear conceptual understanding of fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

PO 3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information technology, engineering specialization, and engineering management to the solution of complex engineering problems.

PO 3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modelling to engineering and social activities with an understanding of the limitations.

PO 4: Complex problem solving, Design and Research

PO 4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as well as natural and social sciences.

PO 4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

PO 4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO 5: Individual & team work and Engineering management

PO 5a: Ability to work effectively as an individual and as a team member or leader in diverse and distributed teams, and in multidisciplinary settings.

PO 5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO 6: Communication: Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO 7: Innovation and entrepreneurship:

PO 7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

PO 7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

## Program Specific Outcomes

### B.Tech. (Civil Engineering)

The civil engineering graduates of JKLU will be able to:

CEPSO1: Conceive, design, implement, and manage civil infrastructure systems, structures and processes by using principles of structural engineering, transportation engineering, water management, geotechnical engineering, project management, computing, automation, sustainability and contemporary materials and tools.

CEPSO2: Serve in fields of construction industry, infrastructure management or consultancy services.

### B.Tech. (Computer Science and Engineering)

The computer science and engineering graduates of JKLU will be able to:

CSEPSO1: Conceive, design, implement, and manage computational and information processing systems, agents and processes by using principles of computer science, computer engineering, software engineering, artificial intelligence, data analytics, sustainability and state of the art platforms, components and tools.

CSEPSO2: Serve in ICT areas such as software development, data science, IT infrastructure, cyber security, data administration, system administration in business, consultancy, industry, government, healthcare, etc.

### B.Tech. (Electrical and Electronics Engineering)

The electrical and electronics engineering graduates of JKLU will be able to:

EEEPSO1: Conceive, design, implement, and manage electrical or electronic systems by using principles of circuit design, machines, communication systems, signal processing, digital systems, power systems, automation, control systems, computing, sustainability and state of the art components and tools.

EEEPSO2: Serve in fields of telecommunication, manufacturing, energy, EPC, IT and engineering services.

### B.Tech. (Mechanical Engineering)

The mechanical engineering graduates of JKLU will be able to:

MEPSO1: Conceive, design, implement, and manage mechanical systems, components, and processes by using principles of machine design, production engineering, thermal engineering, computing, automation, sustainability and contemporary materials and tools.

MEPSO2: Serve in fields of engineering services, manufacturing, automobile, energy, EPC and mechatronics.

# JK Lakshmipat University, Jaipur

**Institute of Engineering and Technology Department of Chemical Engineering**

**Course Structure for the B. Tech (Batch 2016-20)**

| Semester | Courses | | | | | | | (L T P S) Credits / Hrs./Week |
|---|---|---|---|---|---|---|---|---|
| **I** | English Communication Skills | Calculus and Linear Algebra | Engineering Drawing | Engineering Chemistry | Engineering Mechanics | Object Oriented Programming | | (15 3 8) 23 |
| | LA101 (1 0 2 ) 3 | MA102 (3 1 0 ) 4 | CE102 (2 0 2) 3 | CH101 (3 1 2 ) 5 | ME201 (3 1 0 ) 4 | CSE202 (3 0 2 ) 4 | | 26 |
| **II** | Professional Communication Skills | Differential Equations and Complex Analysis | Electrical & Electronics Engineering | Engineering Physics | Environmental Studies | Elements of Engineering | | (13 3 10) 22 |
| | LA201 (0 1 2) 3 | MA202 (3 1 0) 4 | EE101 (3 0 2) 4 | PH101 (3 1 2) 5 | ID201 (2 0 0) 2 | CM101 (2 0 4 ) 4 | | 26 |
| **III** | Chemical Process Calculations | Chemical Engineering Thermodynamics | Chemical Engineering Materials | Fluid Flow Operations & Mechanical Operations | Computer Based Numerical and Statistical Techniques | Principles of Management for Engineers | Self-Development and Behavioral Skills | (17 3 6) 24 |
| | CHE301 (3 1 0) 4 | CHE305 (3 1 0) 4 | CHE306 (3 0 0) 3 | CHE307 (3 1 2) 5 | MA302 (3 0 2) 4 | HS302 (2 0 0) 2 | HS303 (0 0 2) 2 | 26 |
| **IV** | Chemical Reaction Engineering-I | Mass Transfer Operations-I | Heat Transfer Operations | Engineering Optimization | Principles of Economics | Self-Development and Report Writing | | (15 2 10) 23 |
| | CHE404 (3 0 4 )5 | CHE407 (3 1 0 ) 4 | CHE408 (3 1 2 ) 5 | MA405 (3 0 2 ) 4 | HS401 (3 0 0) 3 | HS402 (0 0 2 ) 2 | | 27 |
| **V** | **Practice School - I (PS 501) - (4 to 6 Weeks Duration) - 4 Credits** | | | | | | | (14 2 8) 20+4 |
| | Mass Transfer Operations-II | Process Instrumentation and Control | Chemical Process Technology | Departmental Elective-I | Professional Communication | | | |
| | CHE507 (3 1 2 )5 | CHE508 (3 0 2) 4 | CHE509 (3 0 0) 3 | (3 0 2) 4 | CCT507 (2 1 0) 3 | | | 24 |
| **VI** | Process Equipment Design | Departmental Elective- II | Open Elective-I | Personal Branding &Workplace Communication | Intelligent Automation | | | (13 2 2) 16 |
| | CHE603 (3 1 2) 5 | (3 0 0) 3 | (3 1 0) 4 | (CCT601) (2 0 0)2 | (2 0 0) 2 | | | 17 |
| **VII*** | Advanced Transport Phenomena | Departmental Elective-III | Departmental Elective-IV | Open Elective-II | Minor Project | | | 20 |
| | CH1101 (3 0 2) 4 | 4 | 4 | 4 | PR1103 4 | | | 20 |
| **VIII*** | Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University PR1104 | | | | | | | 16 |
| | **Total Credits** | | | | | | | **168** |

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**B. Tech (CHE) (Batch 2016-2020)**

# JK Lakshmipat University, Jaipur

**Institute of Engineering and Technology Department of Civil Engineering**

**Course Structure for the B. Tech (Batch 2016-20)**

| Sem | Courses | | | | | | | (L T P S) Credits Hrs/Week |
|---|---|---|---|---|---|---|---|---|
| **I** | English Communication Skills | Calculus and Linear Algebra | Engineering Chemistry | Object Oriented Programming | Engineering Mechanics | Engineering Drawing | | (15 3 8 1) 23 |
| | LA101 (1 0 2 1) 3 | MA102 (3 1 0 0) 4 | CH101 (3 1 2 0) 5 | CSE202 (3 0 2 0) 4 | ME201 (3 1 0 0) 4 | CE102 (2 0 2 0) 3 | | 26 |
| **II** | Professional Communication Skills | Differential Equations and Complex Analysis | Engineering Physics | Environmental Studies | Electrical & Electronics Engineering | Elements of Engineering | | (13 3 10 1) 22 |
| | LA201 (0 1 2 1) 3 | MA202 (3 1 0 0) 4 | PH101 (3 1 2 0) 5 | ID201 (2 0 0 0) 2 | EE101 (3 0 2 0) 4 | CM101 (2 0 4 0) 4 | | 26 |
| **III** | Engineering Geology & Construction Materials | Structural Analysis - I | Fluid Mechanics | Surveying | Computer Based Numerical and Statistical Techniques | Self-Development and Behavioral Skills | Principles of Management for Engineers | (17 2 10 1) 25 |
| | CE304 (3 0 2 0) 4 | CE305 (3 1 0 0) 4 | CE306 (3 1 2 0) 5 | CE308 (3 0 2 0) 4 | MA302 (3 0 2 0) 4 | HS303 (0 0 2 1) 2 | HS302 (2 0 0 0) 2 | 29 |
| **IV** | **Survey Field Visit (Intensive Survey) (SUR401) - One Week -2 Credits** | | | | | | | |
| | Structural Analysis -II | Environmental Engineering – I | Building Planning and Drawing | Concrete Technology | Engineering Optimization | Self-Development and Report Writing | Principles of Economics | (18 1 10 1) 25+2 |
| | CE405 (3 1 0 0) 4 | CE407 (3 0 2 0) 4 | CE408 (3 0 2 0) 4 | CE409 (3 0 2 0 )4 | MA405 (3 0 2 0) 4 | HS402 (0 0 2 1) 2 | HS401 (3 0 0) 3 | 29 |
| **V** | **Practice School - I (PS501) - (4 to 6 Weeks Duration) - 4 Credits** | | | | | | | |
| | Design of RCC & Steel Structure | Geotechnical Engineering | Environmental Engineering – II | Hydrology and Water Resources Engineering | Professional Communication | | | (14 2 6 0) 19+4 |
| | CE507 (4 1 0 0) 5 | CE508 (3 0 2 0) 4 | CE509 (3 0 2 0) 4 | CE510 (2 0 2 0) 3 | CCT507 (2 1 0 0) 3 | | | 22 |
| **VI** | Transportation Engineering-I | Geotechnical Engineering-II | Estimating Costing & Evaluation Engineering | Open Elective-I | Personal Branding and Workplace Communication | Intelligent Automation | | (16 1 4 0) 19 |
| | CE 511 (3 0 2 0) 4 | CE608 (3 0 2 0) 4 | CE609 (3 1 0 0) 4 | (3 0 0 0) 3 | CCT601 (2 0 0 0) 2 | ID304 (2 0 0) 2 | | 21 |
| | | | | | | | | |
| **VII** | Construction Project Management | Earthquake Engineering | Departmental Elective | Open Elective-II | Minor Project | | | 20 |
| | CE1110 (3 0 2 0) 4 | CE1111 (3 1 0 0) 4 | 4 | 4 | PR1103 (Credit 4) | | | 19 |
| **VIII** | Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University<br><br>PS801 | | | | | | | 16 |
| | | | | | | | | **Total Credits: 175** |

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## B. Tech (CE) (Batch 2016-20)

# JK Lakshmipat University, Jaipur Institute of Engineering and Technology
## Department of Computer Science Engineering
## Course Structure for the B. Tech (Batch 2016-20)

| Sem | Courses | | | | | | Credits |
|---|---|---|---|---|---|---|---|
| I | English Communication Skills | Calculus and Linear Algebra | Electrical & Electronics Engineering | Engineering Physics | Environmental Studies | Elements of Engineering/Software Foundation and Programming I | |
| | LA101 | MA102 | EE101 | PH101 | ID201 | CM101/CSESP101 | |
| | (1 0 2 1) | (3 1 0 0) | (3 0 2 0) | (3 1 2 0) | (2 0 0 0) | (2 0 4 0) | |
| | 3 | 4 | 4 | 5 | 2 | 4 | 22 |
| II | Professional Communication Skills | Differential Equations and Complex Analysis | Engineering Drawing | Engineering Chemistry | Engineering Mechanics | Object Oriented Programming/ **Software Foundation and Programming II** | |
| | LA201 | MA202 | CE102 | CH101 | ME201 | CSE202/CSESP201 | |
| | (0 1 2 1) | (3 1 0 0) | (2 0 2 0) | (3 1 2 0) | (3 1 0 0) | (3 0 2) | |
| | 3 | 4 | 3 | 5 | 4 | 4 | 23 |
| III | Data Structures | Digital Electronics | Computer Based Numerical and Statistical Techniques | Principles of Management for Engineers | Self-Development and Behavioral Skills | Computing using Python/**Enterprise Reporting Using Business Intelligence/ Enterprise Application Development using Java** | |
| | CSE301 | ECE306 | MA302 | HS302 | HS303 | CSE304/CSESP301 | |
| | (3 0 4 0) | (3 1 2 0) | (3 0 2 0) | (2 0 0 0) | (0 0 2 1) | (3 1 2 0) | |
| | 5 | 5 | 4 | 2 | 2 | 5 | 23 |
| IV | Discrete Structures | Computer Architecture & Organization | Engineering Optimization | Principles of Economics | Self-Development and Report Writing | Database Management Systems/**Information Management Basics** | |
| | CSE402 | CSE403 | MA403 | HS401 | HS402 | CSE401/CSESP301 | |
| | (3 1 0 0) | (3 1 2 0) | (3 0 2 0) | (3 0 0 0) | (0 0 2 1) | (3 1 2 0) | |
| | 4 | 5 | 4 | 3 | 2 | 5 | 23 |
| | **Practice School - I (PS 501) – (4 to 6 Weeks Duration) - 4 Credits** | | | | | | |
| V | Operating System | Computer Networks | Professional Communication | **Open Elective 1** | Computing using Python/Enterprise Reporting Using Business Intelligence/ Enterprise Application Development using Java | Practice School - I | |
| | CSE501 | CSE503 | CCT507 | | CSE555/ CSEBD501/CSESP501 | PS 501 | |
| | (3 0 2 0) | (2 0 4 0) | (2 1 0 0) | | (2 0 4 0)/ (3 0 2 ) | | |
| | 4 | 4 | 3 | 3/4* | 4 | 4 | 22 /23* |
| VI | Design & Analysis of Algorithms | Software Engineering | Personal Banding & Workplace Communication | **Open Elective 2** Advance Course in Entrepreneurship/Cyber Security/Computing with SAS | Intelligent Automation | Theory of Computation/ **Predictive Analytics Modeler/Application Security** | |
| | CSE602 | CSE604 | CCT601 | IM411/CSE601/CSE429 | ID304 | CSE504/ CSEBD601/ CSECC601 | |
| | (2 0 2 0) | (3 0 2 0) | (2 0 0 0) | (3 0 0 0)/ (3 0 2 0) | (2 0 0) | (3 0 0 0)/ (3 0 2 0) | |
| | 3 | 4 | 2 | 3/4* | 2 | 3/4* | 17 /19* |
| VII | Advanced Data Structures and Algorithms | **Departmental Elective-1** | **Departmental Elective-2** | **Open Elective-3** | Minor Project/ **Big Data Analytics/Security Intelligence** | | |
| | CS1114 | | | | PR1103/CS1307/CS1308 | | |
| | (3 0 2) | | | | | | |
| | 4 | 4 | 4 | 4 | 4 | | 20 |
| VIII | Practice School- II/Research Project/Entrepreneurial Project/Semester at a partner University | | | | | | |
| | PS1102/PR1104/PR1105 | | | | | | |
| | 16 | | | | | | 16 |
| | | | | | | Total Credits | 166 /169* |
| | In sixth semester a few students also took an extra course for 2 credits - Automation Project (EEE610), (0 0 2) 2 | | | | | | |

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**B. Tech (CSE) (Batch: 2016-2020)**

## JK Lakshmipat University, Jaipur Institute of Engineering and Technology
## Department of Electronics & Communication Engineering
## Course Structure for the B. Tech (Batch 2016-2020)

| Semester | Courses | | | | | | | (L T P S) Credits<br>Hrs./ Week |
|---|---|---|---|---|---|---|---|---|
| I | English Communication Skills | Calculus and Linear Algebra | Engineering Physics | Electrical & Electronics Engineering | Elements of Engineering | Environmental Studies | | (14 2 10 1) 22 |
| | LA101<br>(1 0 2 1) 3 | MA102<br>(3 1 0 0) 4 | PH101<br>(3 1 2 0) 5 | EE101<br>(3 0 2 0) 4 | (CM101)<br>(2 0 4 0) 4 | ID201<br>(2 0 0 0) 2 | | 26 |
| II | Professional Communication Skills | Differential Equations and Complex Analysis | Engineering Chemistry | Engineering Drawing | Engineering Mechanics | Object Oriented Programming | | (14 4 8 1) 23 |
| | LA201<br>(0 1 2 1) 3 | MA202<br>(3 1 0 0) 4 | CH101<br>(3 1 2 0) 5 | CE102<br>(2 0 2 0) 3 | ME201<br>(3 1 0 0) 4 | CSE202<br>(3 0 2 0) 4 | | 26 |
| III | Electronic Devices & Circuits | Digital Electronics | Control Systems | Computer Based Numerical and Statistical Techniques | Principles of Management for Engineers | Self-Development and Behavioral Skills | | (14 1 8 1) 20 |
| | ECE301<br>(3 0 2 0) 4 | ECE306<br>(3 1 2 0) 5 | ECE304<br>(3 0 0 0 ) 3 | MA302<br>(3 0 2 0) 4 | HS302<br>(2 0 0 0) 2 | HS303<br>(0 0 2 1) 2 | | 23 |
| IV | Analog Electronics | Engineering Signals & Systems | Electromagnetic Field Theory | Engineering Optimization | Principles of Economics | Self-Development and Report Writing | | (15 3 8 1) 23 |
| | ECE401<br>(3 1 2 0) 5 | ECE408<br>(3 1 2 0) 5 | ECE403<br>(3 1 0 0) 4 | MA403<br>(3 0 2 0) 4 | HS401<br>(3 0 0 0) 3 | HS402<br>(0 0 2 1) 2 | | 26 |
| V | **Practice School - I (PS 501) - 4 to 6 Weeks Duration - 4 Credits** | | | | | | | (11 1 10 0)/24<br>(10 1 14 0)/25 |
| | Digital Signal Processing | Analog & Digital Communication | Microprocessors & Microcontrollers | Open Elective-1 | Professional Communication | | | |
| | ECE515<br>(2 0 4 0) 5 | ECE507<br>(3 0 2 0) 5 | ECE510<br>(1 0 4) 4 | (2 0 4 )4 / (3 0 0)3 | CCT507<br>(2 1 0)3 | | | 22/24 |
| VI | Linear Integrated circuits | Wireless communication & Networks | DE-1 | Open Elective-2 | Intelligent Automation | Personal Branding & Workplace Communication | | (16 0 4/6 0)/18 |
| | ECE609<br>(3 0 2 0)5 | ECE731<br>(3 0 0 0)3 | (3 0 2 0) 3 | (3 0 0)/3 0 2) 3 | ID304<br>(2 0 0)2 | CCT601<br>(2 0 0)2 | | 20/22 |
| VII* | Departmental Elective -2 | Departmental Elective -3 | Departmental Elective-4 | Open Elective-3 | Minor Project PR1103 | | | 20 |
| | 4 | 4 | 4 | 4 | 4 | | | 20 |
| VIII* | Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University | | | | | | | 16 |

**Total Credit = 165/166**

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## B.Tech (ECE)(Batch: 2016-2020)

# JK Lakshmipat University, Jaipur
## Institute of Engineering and Technology
## Department of Electrical Engineering
## Course Structure for the B. Tech (Batch 2016-20)

| Semester | Courses | | | | | | | (L T P S) Credits Hrs / Week |
|---|---|---|---|---|---|---|---|---|
| I | English Communication Skills | Calculus and Linear Algebra | Engineering Physics | Electrical & Electronics Engineering | Elements of Engineering | Environmental Studies | | (14 2 10 1) 22 |
| | LA101 (1 0 2 1) 3 | MA102 (3 1 0 0) 4 | PH101 (3 1 2 0) 5 | EE101 (3 0 2 0) 4 | CM101 (2 0 4 0) 4 | ID201 (2 0 0 0) 2 | | 26 |
| II | Professional Communication Skills | Differential Equation and Complexity Analysis | Engineering Drawing | Engineering Chemistry | Engineering Mechanics | Object Oriented Programming | | (14 4 8 1) 23 |
| | LA201 (0 1 2 1) 3 | MA202 (3 1 0 0) 4 | CE102 (2 0 2 0) 3 | CH101 (3 1 2 0) 5 | ME201 (3 1 0 0) 4 | CSE202 (3 0 2 0) 4 | | 26 |
| III | Network Theory-I | Electrical Machines –I | Electronic Devices & Circuits | Measurement & Instrumentation | Computer Based Numerical and Statistical Techniques | Principles of Management for Engineers | Self-Development and Behavioral Skills | (17 1 12 1) 25 |
| | EE301 (3 0 2 0) 4 | EE302 (3 1 2 0) 5 | ECE301 (3 0 2 0) 4 | EE303 (3 0 2 0) 4 | MA302 (3 0 2 0) 4 | HS302 (2 0 0 0) 2 | HS303 (0 0 2 1) 2 | 30 |
| IV | Electrical Machines – II | Network Theory-II | Energy Sources | Digital Electronics | Engineering Optimization | Principles of Economics | Self-Development and Report Writing | (18 2 10 1) 26 |
| | EE401 (3 0 2 0) 4 | EE402 (3 0 0 0) 3 | EE403 (3 1 2 0) 5 | ECE303 (3 1 2 0) 5 | MA404 (3 0 2 0) 4 | HS401 (3 0 0 0) 3 | HS402 (0 0 2 1)2 | 30 |
| V | **Practice School - I (PS 501) – (4 to 6 Weeks Duration) (Credit- 4)** | | | | | | | (12/14 3 6/2 0) (21/20)+ 4 |
| | Linear Control System | Transmission and Distribution of Electrical Power | Advances in Power Delivery | Open Elective-I | Professional Communication | | | |
| | EE501 (3 0 2 0) 5 | EE503 (3 1 0 0) 4 | EE706 (3 1 0 0) 5 | (1 0 4) (4)/ (3 0 0) (3) | CCT507 (2 1 0)(3) | | | 21/19 |
| VI | Power System Analysis | Power System Switchgear & Protection | Industrial Electronics | Open Elective- II | Personal Branding and Workplace Communication | Intelligent Automation | Automation Project | (16 1 6 0) 19 |
| | EE601 (3 1 2)(4) | EE602 (3 0 2)( 4 ) | EE603 (3 0 2)(4) | (3 0 0)(3 ) | CCT601 (2 0 0 )(2) | ID304 (2 0 0) (2) | EE610 (2) | 23 |
| VII* | Departmental Elective -I | Departmental Elective-II | Departmental Elective- III | Open Elective III | Minor Project | | | 20 |
| | 4 | 4 | 4 | 4 | PR1103 (4) | | | 20 hrs. |
| VIII* | Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University | | | | | | | 16 |

Total Credit: 175/176

- In sixth semester a few students also took an extra course for 2 credits - Automation Project (EEE610), (0 0 2) 2

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### B. Tech (EE) (Batch 2016-20)

# JK Lakshmipat University, Jaipur

## Institute of Engineering and Technology

## Department of Mechanical Engineering

## Course Structure for the B. Tech (Batch 2016-20)

| Semester | Courses | | | | | | | (L T P S) Credits<br>Hrs/Week |
|---|---|---|---|---|---|---|---|---|
| I | English Communication Skills | Calculus and Linear Algebra | Engineering Chemistry | Engineering Mechanics | Object Oriented Programming | Engineering Drawing | | (15 3 8 1)<br>23 |
| | LA101<br>(1 0 2 1) 3 | MA102<br>(3 1 0 0) 4 | CH101<br>(3 1 2 0) 5 | ME201<br>(3 1 0 0) 4 | CSE202<br>(3 0 2 0) 4 | CE102<br>(2 0 2 0) 3 | | 26 |
| II | Professional Communication Skills | Differential Equations and Complex Analysis | Engineering Physics | Environmental Studies | Electrical & Electronics Engineering | Elements of Engineering | | (13 3 10 1)<br>22 |
| | LA201<br>(0 1 2 1) 3 | MA202<br>(3 1 0 0) 4 | PH101<br>(3 1 2 0) 5 | ID201<br>(2 0 0 0) 2 | EE101<br>(3 0 2 0) 4 | CM 101<br>(2 0 4 0) 4 | | 26 |
| III | Engineering Thermodynamics | Strength of Materials | Fluid Mechanics & Machines | Machine Drawing | Computer Based Numerical & Statistical Techniques | Principles of Management for Engineers | Self-Development and Behavioral Skills | (14 3 12 1)<br>24 |
| | ME301<br>(3 1 0 0) 4 | ME306<br>(3 1 2 0) 5 | ME308<br>(3 1 2 0) 5 | ME305<br>(0 0 4 0) 2 | MA302<br>(3 0 2 0) 4 | HS302<br>(2 0 0 0) 2 | HS303<br>(0 0 2 1) 2 | 29 |
| IV | Heat Transfer | Production Technology - I | Mechanical Measurements | Materials Science & Engineering | Engineering Optimization | Principles of Economics | Self-Development and Report Writing | (17 1 10 1)<br>24 |
| | ME408<br>(3 1 2 0) 5 | ME405<br>(3 0 2 0) 4 | ME411<br>(3 0 2 0) 4 | ME410<br>(2 0 0 0) 2 | MA405<br>(3 0 2 0) 4 | HS401<br>(3 0 0 0) 3 | HS402<br>(0 0 2 1) 2 | 28 |
| V | **Practice School - I (PS 501) - (4 to 6 Weeks Duration) - 4 Credits** | | | | | | | (14 3 8/6)<br>25/24 |
| | Applied Thermodynamics | Design of Machine Elements – I | Theory of Machines | Open Elective 1 | Professional Communication | | | |
| | ME509<br>(3 1 2) 5 | ME504<br>(3 0 2) 4 | ME507<br>(3 1 2) 5 | (3 0 2/0) 4/3 | CCT507<br>(2 1 0) 3 | | | 25/23 |
| VI | Design of Machine Elements – II | Production Technology – II | Department Elective-1 | Open Elective-2 | Personal Branding & Workplace Communication | Intelligent Automation | | (16 0 8/6)<br>20/19 |
| | ME604<br>(3 0 2) 4 | ME607<br>(3 0 2) 4 | (3 0 2) 4 | (3 0 2/0) 4/3 | CCT601<br>(2 0 0) 2 | ID304<br>(2 0 0) 2 | | 24/22 |
| VII* | Computer Aided Product Design | Departmental Elective – II | Departmental Elective –III | Open Elective-3 | Minor Project | | | 20 |
| | 4 | 4 | 4 | 4 | 4 | | | 20 |
| VIII* | Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University | | | | | | | 16 |
| | *** Subject to change** | | | | | **Total Credits** | | 172-174 |

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

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

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

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

## Syllabus (Theory)

**UNIT I:** Basics of English Grammar, Applied English Grammar and Usage, Paragraph Writing: Definition, Structure of a Paragraph, Construction of a Paragraph, Unity and Coherence, academic essay writing

**UNIT II:** Definition and Characteristic Features of Effective Communication, Barriers to Communication: Types, Ways to overcome effective communication barriers, miscommunication, know what you want to say

**UNIT III:** Vocabulary Extension: Roots, Prefixes and Suffixes, Synonyms, Antonyms, Homophones, One Word Substitution, Learning words through Situations

Reading Comprehension: Problems, Types of Reading Skills, Strategies

**UNIT IV:** Listening Skills: listening for effective information, developing effective listening skills, Self-motivation, Aspiration and Ambitions, Discipline & Time Management, Confidence Building

**UNIT V:** Phonetics and Spoken English: Sounds of English, Word Accent and Weak Forms in English, Intonation, introducing students to the rules of Word Accent and Weak Forms in English, Art of Condensation: Steps Required, Strategies.

## Syllabus (Practical)

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

12. Inculcating the skill of content prediction and inference

## Textbook(s)


1. John Eastwood, Oxford Practice Grammar Intermediate, New Delhi: OUP, 2012.
2. Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011.
3. Krishna Mohan and N.P. Singh, Speaking English Effectively, New Delhi: Macmillan, 1994
4. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-
5. McGraw Hill, 2007.
6. Norman Lewis, Word Power Made Easy, Delhi: Goyal Saab Publishers and Distributors, 1994.
7. A.J. Thomson and A.V. Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.
8. Asha Kaul, Business Communication, Second Edition, New Delhi: PHI, 2010.
9. Edgar Thorpe and Showick Thorpe, Objective English, 2nd Edition, New Delhi: Pearson Education, 2008.


## Web Resource(s)

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

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

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

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

## Syllabus (Theory)

**UNIT I:** CALCULUS OF SEVERAL VARIABLES:
Functions of two or more variables, Partial Derivatives, Total derivative, chain Rule, Euler's Theorem, Jacobian and transformation, Applications to errors
**UNIT II:** INTEGRAL CALCULUS
Solids of revolution: Surface and volume, Multiple Integrals - Double integral: Area, change of order of integration, changing to polar coordinates, Triple Integral
**UNIT III:** VECTOR FUNCTION AND ITS DERIVATIVES
Vector functions, their derivatives and integration, Arc length and UNIT tangent vector, Curvature and UNIT normal vector, Torsion and UNIT Bi-normal vector, Directional derivative and gradient vectors, Tangent plane, Divergence and curl of a vector field

**UNIT IV:** VECTOR INTEGRATION

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

**UNIT V:** LINEAR ALGEBRA

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

## Textbook(s)


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


## Web Resource(s)

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

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

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

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

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

## Syllabus (Theory)

**UNIT I:** Lines, Lettering & Dimension (Sketch Book)

Scales: Representative factor, plain scales, diagonal scales, scale of chords.

Conic sections: Construction of ellipse, parabola, & hyperbola by different methods; Engineering Curves: Cycloid, Epicycloid, Hypocycloid, Involutes, Archimedean and logarithmic spirals.

**UNIT II:** Projection: Types of projection, orthographic projection, first and third angle projection, (Sketch Book)

Projection of points and straight lines: Line inclined to one plane, inclined with both the plane, methods for determining True Length, true Inclinations, and Traces of straight lines.

**UNIT III:** Projection of planes and solids: Projection of Planes like circle and polygons in different positions; Projection of right and regular polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.

**UNIT IV:** Section of Solids: Section of right solids (like Prism, Pyramid, Cylinder and Cone) by normal and inclined planes in different positions; Intersection of cylinders.

Development of Surfaces: Parallel line and radial-line method for right, regular solids.

**UNITV:** Isometric Projections: Isometric scale, Isometric axes, Isometric Projection of solids from orthographic drawing.

Computer Aided Drafting (CAD): Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders; transformations and editing commands like move, rotate, mirror, array; Draw Toolbar, Object & Modify toolbar; solution of projection problems on CAD.

## Syllabus (Practical)

Sketching and drawing of geometries and projections on Sketch Book & on AutoCAD based on above syllabus

**Textbook(s)**

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

**Reference Book(s)**

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

**Web Resource(s)**

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

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

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

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

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

## Syllabus (Theory)

**UNIT I:** Water Chemistry, Introduction, common Impurities in water, Hardness of water, Determination of hardness by Clark's test and complexometric (EDTA) method. Removal of hardness by Lime Soda, Zeolite and Ion exchange process.

Boiler feed water troubles their causes, disadvantages and prevention, Scale & Sludge Carry over (Priming and Foaming), Boiler Corrosion and Caustic embrittlement.

**UNIT II:** POLYMERS, Introduction to Polymer, Classification of polymers. Methods of Polymerization, Plastics: Thermosets and Thermoplastic. Preparation, properties and uses of Vinyl resins, Bakelite, Polyesters and Nylons. Rubbers: Natural rubber, vulcanization, synthetic rubbers e.g. Buna-S, Buna-N, Butyl, Thiokol and Neoprene rubbers.

**UNIT III:** Corrosion & Lubricants, Definition and its significance, Theories of corrosion: Dry corrosion theory, Wet (Electrochemical) theory, Passivity, Types of electrochemical corrosion. Factors influencing rate of corrosion. Introduction, classification, and uses of lubricants. Types of lubrication. Viscosity & viscosity index, Flash point Fire point, cloud and pour point, steam emulsification number, precipitation number and neutralization number.

**UNIT IV:** SOLID STATE CHEMISTRY, Solid State, Types of solids, Space Lattice and UNIT cell, Types of UNIT cell, Cubic System – Number of atoms per UNIT cell, Atomic Radius, Density Calculation of UNIT cell. Bragg's Law X-ray studies of Crystals.

Graphite – Structure, Properties and applications.

Liquid Crystal: Liquid Crystalline state, Classification of liquid crystal and their applications.

**UNITV:** ENGINEERING MATERIALS, Cement: Definition, Composition basic constituents and their significance, manufacturing of Portland cement by Rotary Klin technology. Setting and hardening of cement and role of gypsum.

Nanotechnology and Nano materials: Fullerenes and Carbon Nano tubes - Introduction, Structural properties, preparation and their applications.

## Syllabus (Practical

1. To determine the hardness of water by complex metric method using EDTA.
2. To determine the strength of NaOH and $Na_2CO_3$ in given alkali mixture.
3. To determine the strength of copper sulphate with the help of Hypo solution.
4. Measurement of conductivity of given sample by conductivity meter.
5. Measurement of pH of given sample by pH meter.
6. Determination of Barium as barium sulphate gravimetrically.
7. Measurement of Fluoride in water sample.
8. Determination of Na/K/Ca by Flame photometer in a given sample.
9. To determine the amount of free chlorine in given sample.
10. To determine the viscosity of a given sample of lubricant oil at various temperature.
11. To determine flash and fire point of a given lubricant using Pensky-Martin's apparatus.
12. Measurement of Nitrate and Oxygen in water sample.
13. To determine cloud and pour point of a given sample of lubricating oil using Cloud and Pour point apparatus.

## Textbook(s)

Engineering Chemistry by Jain & Jain (Dhanpat Rai publication)

## Reference Book(s)


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


## Web Resource(s)

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

| Course code | Course Title | | | | | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | T | P | S | Credits |
| ME 201 | Engineering Mechanics | | | | | 3 | 1 | 0 | 0 | 4 |
| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | | | |
| Mid Term Test–I | Mid Term Test–II | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks ** | Mid Term Test-I | End Term Test | Class Participation/ Additional Continuous Evaluation* | | | Total Marks* * |
| 20 | 20 | 50 | 10 | 100 | | | | | | |

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

## Syllabus (Theory)

**UNIT I:** Fundamentals of engineering mechanics, Laws of Motion, Equilibrium, Conditions for equilibrium, and Equations of equilibrium. **Statics of Particles and Rigid Bodies:** System of forces, Resultant force, Resolution of force, Moment and Couples.
**UNIT II: Trusses:** Truss analysis, analysis of frames and machines. **Friction:** Types of Friction, Laws of friction, Angle of friction, Angle of repose, Applications of Friction. **Lifting Machines:** Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of Pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel.
**UNIT III: Properties of Plane Surfaces:** Centroids & Centre of Mass, area of moments, principle moments of inertia, Second moment of mass. **Kinetics of Particles and Rigid Bodies**: Equation of motion in rectangular coordinate, radial and transverse components, Equation of motion in plane for a rigid body. **Impulse and Momentum:** Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body.
**UNIT IV: Virtual work:** Principle of Virtual Work, Active forces and active force diagram.
**Kinematics of Particles and Rigid Bodies:** Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion.
**UNIT V: Work, Energy and Power:** Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy.

## Textbook(s)

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

## Reference Book(s)

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

## Web Resource(s)

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

<table>
<tr><th rowspan="2" colspan="2">Course code</th><th rowspan="2" colspan="4">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="2">CSE202</td><td colspan="4">Object Oriented Programming</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="5">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test–I</th><th>Mid Term Test–II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks **</th><th>Mid Term Test-I</th><th>End Term Test</th><th colspan="2">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks* *</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>40</td><td colspan="2">40</td><td>100</td></tr>
</table>

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

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

## Syllabus (Theory)

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

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

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

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

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

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

## Syllabus (Practical)

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

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

## Textbook(s)

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

## Reference Book(s)

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

## Web Resources

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| LA201 | Professional Communication Skills | 0 | 1 | 2 | 1 | 3 |

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

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

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

## Syllabus (Theory)

**UNIT I:** Professional Communication: Definition, Types, Process, Features Importance of Non-Verbal Communication: Eye contact, Facial Expressions, Gestures, Posture, Proxemics, etc.

**UNIT II:** Importance of Paralinguistic Features: Voice, Volume, Pitch, Intonation, Pauses, Rate, Vocalized Pauses and Vocal Cues.

Group Discussion: Purpose, Difference between GD and Debate, Personality Traits to be Evaluated, dynamics of Group Behaviour, Opening and Ending a GD

**UNIT III:** Job Interviews: Process, Stages, Desirable Qualities, Steps to Preparation, Body Language, Confidence, Frequently Asked Questions

Presentation Skills: Combating Nervousness and Stage Fright, Beginning and Ending of a Presentation, Dynamics of Team Presentations, Using Slides and Audio-Visual Aids

**UNIT IV:** Business Letters and Resume: Structure, Style, Types

Professional Reports: Types, Features, Structure, Style (The Assignment on Report Writing will include technical input from other faculty members from the Institute of Engineering and Technology and will be oriented towards developing in students the competencies required for writing PS-I Reports)

**UNITV:** E-mail Writing, Other Business Writings

## Syllabus (Practical)

1. Sounds of English: Vowel and Consonant Sounds, Word Stress, Intonation - Listening and Practice
2. Reading Comprehension: Reading Passages and Answering Question
3. Vocabulary Extension: Learning Words through Situations and Module
4. Presentation Skills: Learning through Video Presentation
5. Group Discussion: Learning through Recorded Group Discussions
6. Job Interviews: Learning through Recorded Job Interviews

## Textbook(s)

1. Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011

## Reference Book(s)


1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Second Edition, New Delhi: OUP, 2011.
2. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000.
3. Krishna Mohan and N.P. Singh, Speaking English Effectively, New Delhi: Macmillan,1994.
4. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.
5. Norman Lewis, Word Power Made Easy, Delhi: Goyal Saab Publishers and Distributors, 1994.
6. A.J. Thomson and A.V. Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.
7. Asha Kaul, Business Communication, Second Edition, New Delhi: PHI, 2010.
8. Edgar Thorpe and Showick Thorpe, Objective English, 2nd Edition, New Delhi: Pearson Education, 2008.


## Web Resource(s)

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| MA 202 | Differential Equations and Complex Analysis | 3 | 1 | 0 | 0 | 4 |

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

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

## Syllabus (Theory)

**UNIT I:** ORDINARY DIFFERENTIAL EQUATION, Differential equation of first order, Differential equation of higher order with constant coefficients, Differential equation of second order with variable coefficients

**UNIT II:** PARTIAL DIFFERENTIAL EQUATION, Partial Differential Equations of First Order, Variable separable technique for solving PDE, Boundary value problems: Heat equation, wave equation, Laplace equation

**UNIT III:** LAPLACE TRANSFORMS Laplace Transform, Applications of Laplace transform in solving differential equations.

**UNIT IV:** FOURIER TRANSFORM, Fourier transform, Applications of Laplace transform in solving boundary value problems

**UNITV:** SEQUENCES AND SERIES Sequences, Series, Orthogonal function, Fourier series

## Reference Book(s)


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


## Web Resource(s)

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

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

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

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

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

## Syllabus (Theory)

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

## Syllabus (Practical)

ELECTRICAL LAB

1. Single line diagram of a power system and a distribution sub-station and basic functional study of main components used in power systems.
2. Make house wiring including earthling for 1-phase energy meter, MCB, ceiling fan, tube light, three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring
3. Study the construction and basic working of ceiling fan, single phase induction motor and three phase squirrel cage induction motor. Connect ceiling fan along with regulator and single-phase induction motor through autotransformer to run and vary speed.
4. (a) Basic functional study and connection of moving coil & moving iron ammeters and Voltmeters, dynamometer, wattmeter and energy meter.
   (b) Run a 3-phase squirrel cage induction motor at no load and measure its voltage,

current, power and power factor. Reverse the direction of rotation.

5. Study the construction, circuit, working and application of the following lamps: (i) Fluorescent lamp, (ii) Sodium vapour lamp, (iii) Mercury vapour lamp, (iv) Halogen lamp and (v) Neon lamp
6. (a) Study the construction and connection of single-phase transformer and autotransformer. Measure input and output voltage and fin turn ratio.
   (b) Study the construction of a core type three phase transformer. Perform star and delta Connection on a 3-phase transformer and find relation between line and phase voltage.

ELECTRONICS LAB

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

## Textbook(s)

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

## Reference Book(s)

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

## Web Resource(s)

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

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

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

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

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

## Syllabus (Theory)

**UNIT I:** COHERENCE, INTERFERENCE AND OPTICAL TECHNOLOGY

Introduction to optics, Spatial Coherence, Temporal coherence, Coherence length, Coherence time and 'Q' factor for light

Formation of Newton's rings, Measurement of wavelength of light, Diameter of Newton's rings

Elementary idea of anti-reflection coating and interference filters

**UNIT II:** DIFFRACTION

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

**UNIT III:** POLARIZATION

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

**UNIT IV:** LASER AND FIBRE OPTICS

Theory of Laser Action, Einstein's Coefficients, Threshold Conditions for Laser Action. Theory, Design, and Applications of He-Ne Laser. Theory of Semiconductor Lasers. Optical Fibre, Numerical Aperture, and Maximum Angle of Acceptance.

**UNIT V:** QUANTUM MECHANICS

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

## Syllabus (Practical)

1. To determine the wavelength of sodium light by Newton's Ring
2. To determine the specific rotation of Glucose (Sugar) solution using a Polarimeter
3. To measure the Numerical Aperture of an Optical Fibre.
4. To determine coherent length and coherent time of laser using He-Ne Laser
5. To determine the height of object with the help of a Sextant.
6. To determine the dispersive power of material of a Prism for Violet Red and Yellow colours of Mercury light with the help of a spectrometer.
7. To study the Charge & Discharge of a condenser and hence determine time constant (Both current and voltage graphs are to be plotted).
8. To study characteristics of G.M. Counting System.
9. To convert a Galvanometer into an ammeter of range 1.5/3 amp and calibrate it.
10. To convert a Galvanometer into a Volt of range 1.5/3 volt and calibrate it.

## Textbook(s)


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


## Reference Book(s)


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


## Web Resource(s)

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

<table>
<tr><th rowspan="2">Course code</th><th colspan="4" rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>ID201</td><td colspan="4">Environmental Studies</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="5">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test–I</th><th>Mid Term Test–II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks **</th><th>Mid Term Test-I</th><th>End Term Test</th><th colspan="2">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks* *</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td></td><td></td><td colspan="2"></td><td></td></tr>
</table>

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

## Syllabus (Theory)

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

## Textbook(s)

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

## Reference Book(s)

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

## Web Resource(s)

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CM101 | Elements of Engineering | 2 | 0 | 4 | 0 | 4 |
| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | |
| Mid Term Test–I | Mid Term Test–II | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks ** | Mid Term Test-I | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks** |
| 20 | 20 | 50 | 10 | 100 | 20 | 50 | 30 | 100 |

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

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

## Syllabus (Theory)

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

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

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

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

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

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

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

## Syllabus (Practical)

### Mechanical Engineering

1. Basics of manufacturing, types of production systems, ethics, safety in workshop.
2. Metrology, quality, Least Count of a measuring Instrument, measurement with Vernier Caliper or Micrometer.
3. Machining – Demonstration of Turning, Step Turning, Facing, etc.

4. Casting – Demonstration of sand-casting process
5. Forging – Demonstration of forging operations
6. Sheet metal working applications.
7. Hands on practice of Sheet metal working operations using hand tools- Preparation of Funnel.
8. Gas Welding, Demonstration of Gas Welding
9. Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Lap Joint model.
10. Mechanical joining processes, Arc Welding
11. Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Butt Joint model.
12. Introduction to wood working, Wood working Tools, Types of wood, Types of joints.
13. Hands on practice of Wood working operations using hand tools- preparation of Lap Tee Joint, Mechanical joining processes, Soldering, Brazing.
14. Machining – Demonstration of Shaping operations
15. Hands on practice of Fitting operations using hand tools- Prepare a job in fitting shop.

**Civil Engineering**

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

## Textbook(s)

**Elements of Mechanical Engineering**

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

**Elements of Civil Engineering**

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

## Reference Book(s)

1. H S Bawa, "Workshop Practice", TMH, New Delhi, 2nd Edition, 2011.

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

**Web Resource(s)**

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

| Course code | Course Title | | | | | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | T | P | S | Credits |
| CHE301 | Chemical Process Calculations | | | | | 3 | 1 | 0 | 0 | 4 |

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

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

## Syllabus (Theory)

**UNIT 1 - Introduction to Chemical Engineering Calculations:** Units and dimensions, the mole unit, conventions in methods of analysis and measurement, basis, temperature, pressure, the chemical equation and stoichiometry.

**UNIT 2 - Gases, Vapours, Liquids and Solids:** Ideal gas law calculations, real gas relationships, vapour pressure and liquids, saturation, partial saturation and humidity, introduction to vapour-liquid equilibria for multi-component systems, material balances involving condensation and vaporization.

**UNIT 3 - Material Balances:** Material balance of physical processes with and without chemical reaction, including recycle, purge and bypass.

**UNIT 4 - Energy Balances:** Concept and Units, calculation of enthalpy changes, general balance with and without reactions, heats of solution and mixing.

**UNIT 5 - Unsteady-state material and energy balances**. Solids, liquids and gaseous fuels, some industrial examples of the above, simple estimation of physical properties (transport, thermodynamic) of fluids and mixtures

## Textbook(s)

1. Himmelblau, D. M. “Basic principles & calculations in chemical Engg”, PHI, 6$^{th}$ ed., 1997.
2. D.C. Sikdar, “Chemical Process Calculations” PHI Learning Private Limited, second edition, 2013.
3. V. Venikataramani, N. Anantharaman & K.M. Meera Sheriffa Begum. “Process Calculations”, PHI Learning Private Limited, second edition, 2015.

## Reference Books

1. Felder, R. M. & R. W. Rousseau, “Elementary Principles of Chemical Processes”, John Wiley & Sons, Inc., 3rd ed., 2000.
2. Bhatt and Vora, “Stoichiometry,” Tata McGraw-Hill, New Delhi, 3rd edition.
3. Hougen, Watson and Ragatz, “Chemical Process Principles Vol. 1”, Asia Publishing House, New Delhi.
4. Saha, S. N., “Fundamentals of Chemical Engineering,” Dhanpat Rai Publishing Co., New Delhi, 2000.
5. Reklaitis, G.V. Introduction to Material and Energy balances, John Wiley, 1983.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE305 | Chemical Engineering Thermodynamics | 3 | 1 | 0 | 0 | 4 |

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

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

## Syllabus (Theory)

**UNIT 1:** Introduction-Macroscopic and microscopic approach; UNITs; Basic concepts of system, property, force, temperature, pressure, work, energy, heat and equilibrium.
**UNIT 2:** First and Second law of thermodynamics for closed & open system, Heat engines, Entropy, S□for an ideal gas, Entropy balance for Open Systems, Third law, Property relations for homogeneous phases.
**UNIT 3**: Application of law of thermodynamics: Flow process, Refrigeration, Liquefaction process, Steam power-plant: Rankine cycle, Internal combustion engine: Otto cycle, Diesel cycle, Gas Turbine power plant: Brayton cycle.
**UNIT 4:** Thermodynamic Potentials and Thermodynamic Property Relations-Postulates; Intensive properties; Criteria of equilibrium; Euler relation Gibbs Duhem relation; Potentials-A, G, H, U; Property relations for homogeneous phases; Maxwell's relation.
**UNIT 5:** Thermodynamic Properties of Real Gases, Departure functions; Evaluation of departure functions; Partial Molar Property, fugacity and fugacity coefficient, estimation of fugacity coefficient, Thermodynamic Properties of Real Gas mixtures – mixing rules, prediction of P-v-T behaviour, departure functions, fugacity coefficients for real gases.
**UNIT 6:** Ideal solution; phase equilibrium problems; excess properties, excess Gibbs free energy models; Henry'slaw Basic equation for vapour liquid equilibrium; VLE at low to moderate pressures and high pressures-excess Gibbs free energy models, azeotropic data, bubble, dew point and flash calculations; Dilute Solution laws

## Textbook:

1. Smith, J. M., Van Ness, H. C. and Abbott, M. M., "Introduction to Chemical Engineering Thermodynamics", McGraw-Hill, 6$^{th}$ Edition, 2001.

**Reference Books**:

1. Rao, Y. V. C., "An Introduction to Thermodynamics," John Wiley, 1997.
2. Kyle, B.G., "Chemical and Process Thermodynamics", PHI New Delhi, 3rd edition.
3. KV Narayanan, "A Textbook of Chemical Engineering Thermodynamics", Prentice Hall of India, 2001.

**Web Links**

1. https://www.coursera.org/learn/thermodynamics-intro/home/week/1
2. http://www.msubbu.in/lecture/thermodynamics.html
3. http://nptel.ac.in/courses/103101004/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE306 | Chemical Engineering Materials | 3 | 0 | 0 | 0 | 3 |

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

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

## Syllabus (Theory)

**UNIT I-Introduction:** Introduction, UNIT cell, Crystallographic directions and planes, Linear and planner densities, close-packed crystal structures, Crystal structures of ceramics

**UNIT II-Determination of crystal structure:** Determination of crystal structure, Bragg's Law, diffraction technique, Vacancies and interstitials, dislocations and grain boundaries, Optical and electron microscopy, grain size determination

**UNIT III-Deformation of materials:** Steady and non-steady diffusion, Stress-strain, elastic and plastic deformations, Slip systems, plastic deformation, strengthening mechanisms

**UNIT IV- Phase diagrams**: Phases, microstructures, phase equilibria, Fe-Fe3C phase diagram, development of microstructure in Fe-C alloys, Avrami rate equations, Isothermal transformation diagrams, continuous cooling transformations, Mechanical behavior of Fe-C alloys, tempered martensite, Molecular weight, molecular configurations of polymers,

**UNIT V- Deformation mechanisms of materials:** Mechanisms of deformation and strengthening in polymers, glass transitions

## Textbook:

1. W.D. Callister, "Materials Science and Engineering-An introduction", John Wiley, $7^{th}$ edition, 2007.

## Reference Books:

1. V. Raghavan, "Materials science and engineering", Prentice Hall of India, 4th edition.
2. Smith, Hashemi, and Prakash, "Materials science and engineering", Tata McGraw Hill education pvt. Limited, 4th edition, 2008.
3. Askeland and Fulay, "Materials science and engineering", Cengage Learning.

4. Askeland and Phule, “Essentials to Materials Science and Engineering”, Thomson learning, Indian reprint 2007.

**Web links**

1. http://nptel.ac.in/syllabus/syllabus.php subjectId=113106032
2. http://nptel.ac.in/courses/113105057/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE307 | Fluid Flow and Mechanical Operations | 3 | 1 | 2 | 0 | 5 |

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

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

## Syllabus (Theory)

**UNIT I –** Introduction to Fluid Mechanics - Fluid, Fluid types, Thermodynamic properties, Introduction of Viscosity, Fluid statics - pressure distribution in a static fluid, hydrostatic forces on plane surfaces, Illustration by examples.
**UNIT II –** Macroscopic Balances - Control Volume, Reynolds transport theorem, Conservation of mass, Energy and linear momentum balances. Kinetic energy correction factor, Bernoulli equation, illustration by examples, Application of macroscopic balances: Losses in expansion, Force on a reducing bend, Diameter of a free jet; Jet ejector.
**UNIT III -** Differential Balances: Differential equation of mass conservation, Differential equation of linear momentum, Navier-Stokes equations. Applications to Couette flow between a fixed and a moving plate, flow due to pressure gradient between two fixed plates, fully developed laminar pipe flow.
**UNIT VI –** Buckingham PI theorem/ Reyleigh method, significant dimensionless group in fluid mechanics, Viscous flow in a pipe/duct: Head loss, friction factor, frictional loss in high Reynolds no. flow, Effect of wall roughness, the Moody chart, Losses in pipe systems.
**UNIT V –** Fluid Meters device and its measurement, Flow past immersed bodies: Introduction to boundary layer, boundary layer thickness, Drag on a flat plate for laminar, Drag on immersed bodies. Pumps and Compressors
**UNIT VI –** Size reduction and size separation; free and hindered settling, Flow through packed and fluidized beds, centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

## Syllabus (Practical)

1. To determine the friction factor of pipe.

2. To determine the coefficient of discharge of orifice meter/ venturimeter.
3. To verify the Bernoulli's theorem.
4. To find critical Reynolds number for a pipe flow.
5. Crushing, grinding, screening
6. Vacuum filtration/ Plate and frame filtration/ Rotary drum filtration
7. Froth flotation/ Sedimentation and thickening
8. Centrifugal double cone classifier/ Drying
9. Centrifugal pump characteristics
10. Reciprocating pump characteristics

**Textbooks**


1. Fox, R.W. and A.T. McDonalds, Introduction to Fluid Mechanics (5th Ed.), John Wiley & Sons Inc., 2001. [ISBN: 9971-51-355-2]
2. McCabe, W.L., J.C. Smith and P. Harriott, UNIT Operations of Chemical Engineering (7th Ed.), McGraw Hill Inc., 2005. [ISBN 007-124710-6]


**Reference Books**


1. Bird, R.B., W.E. Stewart and E.N. Lightfoot, Transport Phenomena (2nd Ed.), John Wiley and Sons Inc., 2002.
2. Welty, J.R., C.E. Wicks, R.E. Wilson, and G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer (4th Ed.), John Wiley and Sons Inc., 2001.
3. Coulson, J. M. and J. F. Richardson (with J. R. Backhurst and J. H. Harker), Coulson & Richardson's Chemical Engineering-Volume 1 (5th Ed.), Pergamon Press. Strength of Materials- A Rudimentary Approach – M.A. Jayaram,
4. Brown, G. G., et al, "UNIT Operations," CBS Publishers & Distributors, New Delhi, 1995.


**Web Links**

1. http://nptel.ac.in/courses/103107123/
2. http://nptel.ac.in/courses/103104044/
3. http://nptel.ac.in/courses/103104043/

| Course code | Course Title | | | | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | S | Credits |
| MA302 | Computer Based Numerical and Statistical Techniques | | | | 3 | 0 | 2 | 0 | 4 |
| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | | |
| Mid Term Test - I | Mid Term Test - II | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks | Mid Term Test - I | End Term Test | Class Participation/ Additional Continuous Evaluation* | | Total Marks** |
| 20 | 20 | 50 | 10 | 100 | 20 | 50 | 30 | | 100 |

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

## Syllabus (Theory)

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

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

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

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

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

## Syllabus (Practical)

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

1. Numerical solution of algebraic and transcendental equations.
2. Numerical solution of system of linear equations.
3. Interpolation.
4. Numerical differentiation.
5. Numerical integration.
6. Numerical solution of differential equations.

7. Data Analysis using Correlation and Regression
8. Test of Hypothesis

## Textbooks and Reference books


1. Srimanta Pal, Numerical Methods: Principles, Analyses and Algorithms, Oxford University Press, New Delhi.
2. Rishard A. Johnson, Miller and Freund's probability and Statistics for Engineers, PHI, 8th Ed.
3. K. E. Atkinson, Introduction to Numerical Analysis, John Wiley and Sons.
4. M.K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific And Engineering Computation, New age International publishers, New Delhi.
5. Steven C Chapra, Raymond P Canale, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3rd Editions, Tata Mc Graw Hill, New Delhi, 2012.
6. Cheney and Kincaid, Numerical Methods and Applications, Cengage Publications, New Delhi.
7. Cleve B. Moler, Numerical Computing with MATLAB, Prentice Hall of India, New Delhi.
8. Ravichandran J., Probability and statistics for Engineers, Wiley India, New Delhi.
9. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition (2004).
10. Prem S. Mann, Introductory Statistics, Wiley publication, 7th edition.

<table>
<tr><td colspan="3" rowspan="2">Course code</td><td colspan="3" rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td colspan="3">HS302</td><td colspan="3">Principles of Management for Engineers</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="6">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test - I</td><td>Mid Term Test - II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks</td><td>Mid Term Test - I</td><td>End Term Test</td><td>Class Participation</td><td>Additional Continuous Evaluation*</td><td colspan="2">Total Marks</td></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2">-</td></tr>
</table>

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

## Course Syllabus (Theory):

**Concepts of management:** Functions and Responsibilities of managers, Principles of management and visiting various, Schools of management Thoughts in developing, excellent managers

**Planning:** Nature and purpose of planning, Planning process and principles, Types of planning, Advantages and disadvantages of planning, Concept of objectives and types of objectives, Case analysis

**Organizing:** Nature and purpose of organizing, Process of organizing, Span of management and determination of span of management, Principles of organizing, Departmentalization, delegation and, Decentralization. Case analysis

**Directing and leading:** Requirements of Effective directions, giving orders, motivation, Nature of leadership, leadership and management, Recapitulation and case discussion

**Controlling:** concept and process, need for controlling and types of control methods, Essentials of effective control, Benefits and problems in control systems. Case analysis Social responsibilities of business: Meaning, Social responsibility of business towards different groups, Social performance of business in India, Social audit, Business ethics and corporate governance

## Text Books:

1. Tripathy, P.C. and Reddy, P. N. "Principles of Management". McGraw Hill, New Delhi.4th ed. 2008.

## Reference Books:

1. Koontz, Herold and Weihrich, Heinz. "Management". McGraw Hill, New York. 9th ed. 1988.

2. Stoner, James A. F. and Freeman, R Edward. "Management". Prentice Hall of India, New Delhi. 6th e, 1989.
3. Bateman, T. S. and Snell, S . A. "Management: Leading and Collaborating in a Competitive World", McGraw Hill Irwin. 8th edition, 2009.
4. Draft, R. L. "Principles of Management". Cengage learning.2009
5. Schermerhron, J. R. "Introduction to Management", 10th edition, Wiley India. 2009

<table>
<tr><td colspan="2" rowspan="2">Course code</td><td colspan="3" rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td colspan="2">HS303</td><td colspan="3">Self-Development and Behavioral Skills</td><td>0</td><td>0</td><td>2</td><td>1</td><td>2</td></tr>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="5">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test – I</td><td>Mid Term Test – II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks**</td><td>Mid Term Test - I</td><td>End Term Test</td><td colspan="2">Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks**</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>20</td><td>50</td><td colspan="2">30</td><td>100</td></tr>
</table>

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

## Syllabus (Theory)

**UNIT-I:** Self-introduction methods, Telephonic Etiquettes, Manners & Etiquette, Video CV, CV Writing, Application and Cover letter writing,

**UNIT-II:** Multicultural Diversity, Self-Reliance, Adaptability, Initiative & Entrepreneurship, Winning from Failures, working without or less supervision, Self-Grooming, Attitude, Confidence building, Problem Solving

**UNIT-III:** Quantitative Skills: Number System, HCF and LCM, Averages, Ratio and Proportions, Percentage, Age Problems

**UNIT-IV:** Logical Reasoning: Alpha Numerical, Letter & Symbol Series, Numerical and Alphabet Puzzles, logical sequence and matching, Venn diagrams

**UNIT-V:** Mock Interview, Mock Group Discussion, Mock Presentations

## Text and Reference Books


1. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000
2. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning (English) Revised Edition, S. Chand.
3. R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations (English) 7th Edition, S. Chand.
4. Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011
5. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Second Edition, New Delhi: OUP, 2011.
6. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000.
7. Krishna Mohan and N.P. Singh, Speaking English Effectively, New Delhi: Macmillan, 1994.

8. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.
9. Norman Lewis, Word Power Made Easy, Delhi: Goyal Saab Publishers and Distributors, 1994.
10. A.J. Thomson and A.V. Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.

**Syllabus (Practical)**

1. Telephonic Etiquettes: Learning through Video
2. Self-introduction: Learning through Video
3. Developing Life Skills: Learning through Video
4. Designing CV and cover letter
5. Professional presentations
6. Participation in mock Group Discussion
7. Participation in mock Job Interviews

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE404 | Chemical Reaction Engineering - I | 3 | 0 | 4 | 0 | 5 |

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

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

## Syllabus (Theory)

**UNIT 1 - Introduction:** Definition of reaction rates, variable affecting reaction rates, classification of reactions, order, molecularity.
**UNIT 2 - Kinetics of Homogenous Reactions:** Concentration dependent term of a rate equation, temperature dependent term of a rate equation, searching for a mechanism.
**UNIT 3 - Interpretation of Batch Reactor Data:** Constant volume batch reactor, variable volume batch reactor, temperature and reaction rate.
**UNIT 4 - Introduction to Reactor Design:** Ideal reactors for single reaction: Ideal batch reactor, steady state mixed flow Reactor, steady state PFR, Holding time and space time for flow systems.
**UNIT 5 - Design for single reactions:** Size comparison, multiple reactor systems, recycle reactor, auto catalytic reactions.
**UNIT 6 - Design for multiple reactions:** Reactions in parallel, reactions in series, series – parallel reactions.
**UNIT 7 - Temperature and Pressure Effects on Reactions**: Single reactions: Heat of reaction, equilibrium constants, graphical design procedure, optimum temperature progression, adiabatic operations. Multiple reactions: Product distribution and temperature.
**UNIT 8 - Stability of Multiple Steady –States:** Multiple steady-states of a CSTR with a first order reaction, Ignition –extinction curve.

## Syllabus (Practical)

1. Isothermal CSTR
2. CSTRs in Series
3. Plug flow reactor (straight tube type)
4. Isothermal plug flow reactor (coiled tube type)

5. Isothermal batch reactor
6. Isothermal semi-batch reactor
7. Packed bed reactor
8. RTD studies in CSTR
9. RTD studies in plug flow reactor (coiled tube type)
10. RTD of packed bed reactor

**Text/Reference Books:**


1. Levenspiel, O., "Chemical Reaction Engineering" 3rd ed., John Wiley & Sons, Singapore 1999.
2. Fogler, H.S., "Elements of Chemical Reaction Engineering" 3rd ed., Prentice Hall of India, 2003.
3. Smith, J.M. "Chemical Engineering Kinetics", 3rded., McGraw-Hill, 1981.
4. Dawande S.D. "Principles of Chemical Reaction Engineering," 2nd ed., Central Techno Publications, Nagpur, 2003.
5. Richardson, J.F. and peacock D.G., "Coulson and Richardson's Chemical Engineering," Vol.3, 3rd ed. Asian Books Pvt. Ltd. New Delhi 1998.


**Web links**

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103108097
2. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103106116
3. http://umich.edu/~elements/
4. http://ocw.mit.edu/courses/chemical-engineering/10-37-chemical-and-biological-reaction-engineering-spring-2007/
5. http://www.msubbu.in/sp/cre/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE407 | Mass Transfer Operations-I | 3 | 1 | 0 | 0 | 4 |

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

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

## Syllabus (Theory)

**UNIT I-UNIT operations and UNIT process, Basic concepts**: phase, equilibrium, property, system, driving force, chemical potential. Classification of mass transfer operations. Molecular diffusion and fluxes; Diffusion phenomenon: Molecular and eddy diffusion in gases, liquids and solids, interface mass transfer Mass transfer theories: Film theory, penetration theory and surface renewal theory.

**UNIT II-Concept of Mass transfer coefficient:** Individual and film coefficients, overall mass transfer co-efficient and their inter relationships. Continuous contact and differential contact, mass transfer concepts of NTU and HTU, their inter relationship.

Interphase Mass Transfer: Equilibrium, diffusion between phases, material balances, stages and concept of operating line and tie line.

**UNIT III-Equipment for gas liquid contact:** Sparged vessel, mechanically agitated vessel, tray towers, venture scrubber, wetted wall towers, spray towers and packed towers, tray tower vs packed tower.

Absorption: Absorption in continuous contact columns, Co-current, Counter current and cross current contacting of fluids, calculation of NTU and HTU, concept of HETP.

**UNIT IV-Adsorption:** Adsorption theories, types of adsorbent, activated carbon silica, silica and molecular sieves, Batch and column adsorption. Break through curves, gas adsorption, BDST models for adsorption calculation.

**UNIT V-Humidification and Drying:** General theory, psychometric chart, fundamental concepts in humidification and dehumidification, dry bulb and wet bulb temperature, adiabatic saturation temperature, measurement of humidity, calculation of humidification operation, cooling towers and related equipments. Equilibrium mechanism theory of drying, drying rate curve, Batch and continuous drying, working principle of different types of dryers such as tray driers, Drum dryers, spray and tunnel dryers.

## Textbooks:

1. Treybal, R.E., “Mass Transfer Operations,” 3rd Ed. (International Edition), McGraw-Hill Book Company, Singapore, 1980.
2. McCabe, W. L., Smith, J. C., Harriott, P., “UNIT Operations of Chemical Engineering,” 7th Ed. (International Edition), McGraw-Hill Education (Asia), Singapore, 2005.

## Reference Books:

1. Dutta, B. K., “Principles of Mass Transfer and Separation Processes”, PHI Learning Pvt. Ltd. New Delhi, 2007.
2. Foust, A. S., Wenzel, L. A., Clump, C. W., Anderson, L. B., “Principles of UNIT Operations,” John Wiley and Sons, New York, 2nd Ed., 1980.
3. Perry, R. H., Green, D. W., “Perry’s Chemical Engineers’ Handbook,” McGraw-Hill, New York, 7th Ed., 2001.
4. Smith, B.D., “Design of Equilibrium stage Processes”, McGraw-Hill, NY
5. King, C.J. “Separation Processes”, McGraw –Hill, NY.
6. Coulson, J.M. and Richardson, J.F., “Chemical Engineering”, Vol. I and II, Asian Books Pvt., New Delhi.

## Web links

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103103034
2. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103103035
3. http://www.msubbu.in/ln/
4. http://www.bput.ac.in/lecture_notes/MASS_TRANSFER_I.pdf

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE408 | Heat Transfer Operations | 3 | 1 | 2 | 0 | 5 |

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

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

## Syllabus (Theory):

**UNIT 1 – Introduction:** Introduction to conductive, convective and radiative heat transfer
**UNIT 2 – Steady state conduction:** One dimensional steady state conduction for cartesian, radial and spherical coordinate system, with and without heat source, Fins and their function, Thermal contact resistance
**UNIT 3 – Unsteady state conduction:** Lumped heat capacity system, Transient heat flow in a semi-infinite solid,
**UNIT 4 – Forced Convection:** Convective boundary conditions; Boundary layer heat transfer; internal and external flow, in noncircular sections, in spherical particles. Film and overall heat transfer coefficients.
**UNIT 5 – Free Convection:** Theory and empirical relations for free convection from different geometric configurations such as plates, inclined surface, cylinder, sphere etc.; combined free and forced convection
**UNIT 6 – Radiation:** Mechanism and properties of radiation; Shape factor; Back body and gray body radiation; Gas radiation; Radiation shield; Radiation network
**UNIT 7 – Boiling and Condensation:** Theory and empirical relations for film and dropwise condensation and boiling phenomena; Heat pipe
**UNIT 8 – Heat Exchanger:** Concept of overall heat transfer coefficient; LMTD method, effectiveness-NTU method, and Kern's method for heat exchanger design; Compact heat exchangers
**UNIT 9 – Evaporators:** Types of evaporators; Evaporator capacity and economy; Single and multiple effect evaporators

## Syllabus (Practical)

1 To analyse the performance of a shell and tube heat exchanger
2 To determine the thermal conductivity of liquid
3 To analyse the performance of a plate type heat exchanger
4 To obtain the experimental overall heat transfer coefficient (U) and compare it with theoretical
5 To analyse the performance of an existing double pipe heat exchanger
6 To study heat transfer rate, overall heat transfer coefficient, effectiveness and % increase in heat dissipation by use of (1) Transverse and (2) Longitudinal fins in Parallel and Counter flow mode.
7 To study the unsteady state temperature response of finite geometric shapes and also calculate the value of surface conductance (h).
8 To study the performance of heating of heat pipe and compare its working with the best conductor.
9 To determine the Stefan Boltzmann constant.
10 Study the heat transfer through packed bed column.
11 Study of double effect evaporator
12 To determine the overall heat transfer coefficient and the economy of open pan evaporator when evaporating saturated sodium chloride brine.
13 To determine the inside and outside heat transfer coefficient of Dropwise and Film wise condensation apparatus

## Textbook:


1. Holman, J.P., “Heat Transfer (9th Ed.)”, McGraw Hill, 2002.
2. Heat and Mass Transfer, Cengel, Tata McGraw Hill, New Delhi
3. Fundamentals of Heat and Mass Tranfer – Incropera and Dewitt


## Reference books:


1. Kern, D. Q., “Process Heat Transfer”, Tata- McGraw Hill, 1950.
2. McCabe, W.L., J.C. Smith, and P. Harriott, “UNIT Operations of Chemical Engineering”, McGraw Hill, 6th Ed., 2001.
3. Bird, R.B., W.E. Stewart, and E.N. Lightfoot, “Transport Phenomena”, John Wiley & Sons, 1994.
4. Welty, J.R., C.E. Wicks, R.E. Wilson, and G.L. Rorrer, “Fundamentals of Momentum, Heat and Mass Transfer”, John Wiley & Sons, 4th Ed., 2001.

5. Binay, K. Dutta, “Heat Transfer- Principles and Applications”, Prentice-Hall of India, 1st Ed., 2001.
6. Kumar D. S., “Heat and Mass Transfer”, Kataria and sons

**<u>Web links</u>**

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103103032
2. http://nptel.ac.in/courses/112101097/
3. http://web.iitd.ac.in/~prabal/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| MA405 | Engineering Optimization | 3 | 0 | 2 | 0 | 4 |

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

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

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

## Syllabus (Theory)

**UNIT – I: Linear Programming Problems:** Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem

**UNIT – II: Non-Linear Programming Problems:** Introduction, Single variable and multi variable optimization, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming, Mixed Integer Programming

**UNIT – III: Project and Simulation:** Simulation, Project Management with CPM/PERT

**UNIT-IV: Introduction to Evolutionary Algorithms:** Nature Inspired Algorithms: Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization

**UNIT – IV: Engineering Applications:** Inventory Theory, Optimization in Mechanical, Civil and Chemical Engineering, Case Study

## Syllabus (Practical)

Problem solving using various software packages for the following areas.

1. Linear Programming
2. Non-linear Programming
3. Engineering problems solving
4. Case Study

## <u>Textbooks and Reference books</u>


1. S S Rao, Engineering Optimization: Theory and Practices, New Age International, 1996.
2. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.
3. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2003.

4. Ronald L. Rardin, Optimization in Operations Research. Pearson Education, First Indian Reprint 2002.
5. Pant. J. C., Introduction to Optimization: Operations Research, Jain Brothers, 5th Ed., 2000.
6. Sharma. S. D., Operations Research, Kedarnath Ramnath & Co., 15th Edition, 2006.
7. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, PHI.
8. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| HS401 | Principle of Economics | 3 | 0 | 0 | 0 | 3 |

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

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

## Syllabus (Theory)

Definition of Economics and role of economics in Engineering and Technology; Basic economic terms; The economy, working of an economy, kinds of an economy and its basic problems; Laws of Demand and Supply and market Equilibrium; Elasticity of demand its measurements and application, Production function and law of Variable Proportion and Law of Returns to Scale; Concepts of cost and revenue, short run and long run cost function; Profit maximization hypothesis, Price and output determination under Perfect Competition, Monopolistic competition and Monopoly.
Measurement of macroeconomic aggregates, National Income, Consumption, saving and investment function; Macroeconomic issues: Inflation, Unemployment and Economic growth International aspects of macroeconomics; Foreign Exchange rate and Balance of payments.

## Textbook(s)

1. T.R. Jain and M.L. Grover, "Economics for Engineers", V. K. (India) Enterprises

## Reference Book(s)

1. D N Dwivedi "Principles of Economics", Vikas Publishing House Pvt Ltd.
2. G. Mankiew. Economics Principles and Applications. Cengage Learning

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| HS402 | Self-Development and Report Writing | 0 | 0 | 2 | 1 | 2 |

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

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

## Syllabus (Theory)

**UNIT I:** Technical report writing, Project report writing and presentation, Project summary and proposal writing, Power point presentation skills

**UNIT II:** Workplaces behavioral skills, Industry Related Practices, Professional Etiquettes, Databank Development & Content, Data Sufficiency Questions, Data Interpretation, Working on Excel

**UNIT III:** Quantitative Skills: Profit and Loss, Time and Distance, Time and Work, Calendar, Interest, Stocks and Shares, Partnership

**UNIT IV:** Logical Reasoning: Seating Arrangement, Coding and Decoding, Statement and Argument, Logical Deductive Reasoning, Logical Games

**UNIT V:** Mock Interviews, Mock Group Discussion, Mock Presentation, Case Studies

## Syllabus (Practical)

1. Training on Project report writing
2. Understating the nuances of power point presentation
3. Presentation of project report
4. Training on Proposal writing
5. Professional Etiquettes: Learning through Video
6. Workplaces behavioral skills: Learning through Video
7. Data Interpretation
8. Working on Excel
9. Case study discussion
10. Participation in mock Group Discussion
11. Participation in mock Job Interviews

**Text and Reference Books**


1. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000
2. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning (English) Revised Edition, S. Chand.
3. R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations (English) 7th Edition, S. Chand.
4. Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011
5. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Second Edition, New Delhi: OUP, 2011.
6. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000.
7. Krishna Mohan and N.P. Singh, Speaking English Effectively, New Delhi: Macmillan,1994.
8. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.
9. Norman Lewis, Word Power Made Easy, Delhi: Goyal Saab Publishers and Distributors, 1994.
10. A.J. Thomson and A.V. Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.
11. Asha Kaul, Business Communication, Second Edition, New Delhi: PHI, 2010.
12. Edgar Thorpe and Showick Thorpe, Objective English, 2nd Edition, New Delhi: Pearson Education, 2008.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>PS501</td><td>Practice School – I</td><td></td><td></td><td></td><td></td><td>4</td></tr>
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<table>
<tr><th colspan="3">Evaluation Scheme</th></tr>
<tr><th>S. No.</th><th>Evaluation Component</th><th>Marks (100) (Weightage %)</th></tr>
<tr><td>1</td><td>Quiz-I</td><td>4</td></tr>
<tr><td>2</td><td>Quiz-II</td><td>4</td></tr>
<tr><td>3</td><td>Group Discussion-I</td><td>4</td></tr>
<tr><td>4</td><td>Group Discussion-II</td><td>4</td></tr>
<tr><td>5</td><td>Seminar-I</td><td>4</td></tr>
<tr><td>6</td><td>Seminar-II</td><td>4</td></tr>
<tr><td>7</td><td>Diary-I</td><td>4</td></tr>
<tr><td>8</td><td>Diary-II</td><td>4</td></tr>
<tr><td>9</td><td>Observation-I</td><td>4</td></tr>
<tr><td>10</td><td>Observation- II</td><td>4</td></tr>
<tr><td>11</td><td>Mid Term Evaluation (Project Report and Presentation/Viva)</td><td>20</td></tr>
<tr><td>12</td><td>Final Evaluation (Project Report and Presentation/Viva)</td><td>40</td></tr>
</table>

**Course Syllabi:**

This course is for 6 weeks at the end of 4th semester during summer term of 4-year full time B. Tech. and 5 year Integrated Dual degree (B.Tech + M.Tech, B.Tech + MBA) programs in all the engineering disciplines. The objective of this programme is to provide the students an understanding of working of corporate world in various functions associated with an Industry/Organization. During this programme, they will observe and learn various real-world applications of their curricula and develop an understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, data analysis etc. The general nature of PS - 1 assignments is of study and orientation. Duration of internship is 45 days for PS - 1. PS - I Summer internship May to July.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE507 | Mass Transfer Operations - II | 3 | 1 | 2 | 0 | 5 |

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

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

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

## Syllabus (Theory)

**UNIT I-Distillation:** Vapor liquid Equilibria, Boiling point diagram, Relative volatility, flash and differential distillation for two component mixture, steam distillation, azeotropic distillation, extractive distillation. Continuous and differential contact distillation: Rectification, reflux ratio and its importance, Minimum reflux, total and optimum reflux ration, material balance and Q-line equation, open steam, multiple feed and multiple product calculations, Enthalpy concentration diagram, panchon-Savarit and McCabe Thiele method for calculation of number of plates. Approximate equation; Fensky and underwood equation for minimum reflux and minimum number of plate calculation, Batch distillation.
**UNIT II-Liquid–Liquid extraction:** Liquid-Liquid equilibrium, packed and spray column, conjugate curve and tie line data, plait-point, ternary liquid-liquid extraction, co-current, counter current and parallel current system, Hunter-Nash graphical equilibrium stage method, selection of solvent for extraction.
**UNIT III-Leaching:** Solid-liquid equilibrium, Equipment, principles of leaching, co-current and counter current systems and calculation of number of stages required
**UNIT IV-Crystallization:** Supersaturation, methods to achieve supersaturation, Factors governing nucleation and crystal growth rates, controlled-growth of crystals, super saturation curve, principle and design of batch and continuous type crystallizers, Inverted soliability, fractional crystallization.

## Syllabus (Practical)

1. Liquid-liquid extraction in a packed tower
2. York scheibel’s extraction unit
3. Solid-liquid extraction (bonnotto type)

4. Sieve plate distillation column
5. Simple batch distillation setup
6. Absorption in wetted wall column
7. Vapour in air diffusion apparatus
8. Fluidized bed dryer
9. Batch crystallizer
10. Vapour-liquid equilibrium set-up
11. Mass transfer with & without chemical reaction (solid- liquid)
12. Adsorption in packed bed

**Textbooks:**


1. Treybal, R.E., "Mass Transfer Operations", McGraw-Hill Book Company, Singapore, 3rd Edition (International Edition), 1980.
2. McCabe, W. L., Smith, J. C., Harriott, P., "Unit Operations of Chemical Engineering", McGraw-Hill Education (Asia), Singapore, 7th Ed. (International Edition), 2005.


**Reference Books:**


1. Dutta, B. K., "Principles of Mass Transfer and Separation Processes", PHI Learning Pvt. Ltd. New Delhi, 2007.
2. Seader, J.D., Henley, E.J., "Separation Process Principles", Wiley India Pvt. Ltd., New Delhi, 2nd Edition, 2006.
3. Foust, A. S., Wenzel, L. A., Clump, C. W., Anderson, L. B., "Principles of UNIT Operations", John Wiley and Sons, New York, 2nd Ed., 1980.
4. Perry, R. H., Green, D. W., "Perry's Chemical Engineers' Handbook", McGraw-Hill, New York, 7th Ed., 2001.
5. Smith, B.D., "Design of Equilibrium stage Processes", McGraw-Hill, NY
6. King, C.J. "Separation Processes", McGraw –Hill, NY.
7. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I and II, Asian Books Pvt., New Delhi.


**Web links**

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103104046
2. http://www.msubbu.in/ln/

3. http://www.bput.ac.in/lecture_notes/MASS_TRANSFER_I.pdf
4. https://1rv07ch.files.wordpress.com/2010/05/lecture1-introduction2mass-transfer.pdf

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>CHE508</td><td>Process Instrumentation and Control</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
</table>

<table>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test - II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td>30</td><td>100</td></tr>
</table>

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

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

## Syllabus (Theory)

**UNIT I-Introduction to process instrumentation:** Introduction to instrumentation and process control. Measuring instruments for: Temperature, pressure, level, flow, composition, pH.

**UNIT II-Linear open loop systems:** Dynamic behavior of first, second and higher order physical systems. Interacting and non-interacting processes. Linearization of non-linear systems. Controller hardware, transducers, sensors, transmitters and control valves.

**UNIT III-Linear closed loop systems:** Basic concepts of feedback control: Control loop and its elements; servo and regulatory problems; P, PI, PID controllers.

**UNIT IV-Stability and Frequency Response:** Stability of control loop using Routh's test. Introduction to root locus method. Frequency response analysis: Bode stability criteria and Nyquist plot.

**UNIT V-Introduction to advanced control systems:** feed forward, cascade, ratio control. Design of single loop feedback control systems and tuning of feedback controllers. Cohen-Coon method, 1/4th decay ratio method, direct synthesis methods, gain and phase margins, Ziegler-Nichols method. Control schemes with applications to distillation systems, chemical reactors, heat exchangers, boilers etc. State space representation of physical system. Transfer function matrix and multivariable control.

**UNIT VI-PFD and P&ID:** Instrumentation symbols introduction to process flow diagram (PFD) and piping & instrumentation diagram (P&ID)

## Syllabus (Practical)

1. Transient Response of First order and second order system
2. Transient Response of First order system in series: interacting and non-interacting mode
3. Study characteristics of flapper nozzle system

4. Study of I/P and P/I converter
5. Temperature Control Trainer
6. Pressure Control Trainer
7. Control valve characteristics (linear, equal percent & quick opening)
8. Multi process trainer: level, flow, cascade, ratio &feedforward (SCADA)
9. Multi variable control trainer

**Textbooks:**


1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw-Hill, 2nd Ed., 1991.
2. George Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice Hall, 1984.


**Reference Books:**


1. Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., “Process Dynamics and Control”, John Wiley and Sons, 2nd Ed., 2004
2. Ogunnaike, B.A., Ray, W.H., “Process Dynamics, Modelling and Control”, Oxford University Press,1994
3. Nakra, “Instrumentation, Measurement and Analysis”; Tata McGraw Hill, New Delhi.
4. Patranabis, D., “Principles of Industrial Instrumentation”, Tata McGraw Hill, New Delhi 2ndedition.
5. Eckman, D.P., “Industrial Instrumentation”, Wiley Eastern, 1978.
6. Liptak, B.G., “Industrial Engineers’ Handbook volume 1 & 2”, CRC Press, 1994.
7. Andrew, W.G., et al., “Applied Instrumentation in the Process Industries”, Gulf Pub.1993.
8. Wightman, E.J., “Instrumentation in Process Control”, Butterworth, 1972.
9. Doebelin, E., “Measurement Systems: Applications and Design”, McGraw Hill, 4thed., 1990


**Web links**

1. http://ocw.mit.edu/courses/chemical-engineering/10-450-process-dynamics-operations-and-control-spring-2006/
2. http://nptel.ac.in/courses/103105064/
3. http://nptel.ac.in/courses/103103037/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE509 | Chemical Process Technology | 3 | 0 | 0 | 0 | 3 |

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

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

## Syllabus (Theory):

**UNIT I-Introduction:** Chemical Industries – Facts and figures, UNIT operations and UNIT Process concepts, General Principles applied in studying an Industry

**UNIT II- Pulp and Paper:** Raw materials, pulping processes, recovery of chemicals, stock preparation and paper making.

**UNIT III- Coal Chemicals:** Various processes for obtaining coal chemicals, coal tar distillation, F-T and Bergious processes for hydrocarbon production.

**UNIT IV- Agrochemicals:** Important pesticides, BHC, DDT, Malathion.

**UNIT V- Cement Industries:** Dry and Wet Cement Manufacturing processes

**UNIT VI- Sulphur Industries:** Origin and extraction of sulphur, production routes of suphuric acid and oleum.

**UNIT VII- Chlor-Alkali Industries:** Production of common salt, caustic soda, chlorine, hydrochloric acid and soda ash.

**UNIT VIII- Nitrogen Industries:** Manufacturing of ammonia, nitric acid, nitrogenous and mixed fertilizers.

**UNIT IX - Oils and Fats:** Oils, Fats and Waxes, Soaps and Detergents.

## Textbooks:

1. M. Gopala Rao and Marshall Sittig, "Dryden's Outlines of Chemical Technology for the 21st Century" East West Press, 3rd Ed., 1997.

## Reference Books:

1. George T. Austin, "Shreve's Chemical Process Industries", McGraw Hill, 5th Edn., 1984.
2. D. Sen, "Reference book on Chemical Engineering, Vol- I", New Age International Publishers, 2005

3. Moulijn J. K; Makkee M. and van Diepen A; "Chemical Process Technology", Wiley.
4. Basta N; "Shreve's Chemical Process Industries Handbook", 5th Ed; McGraw Hill.

**<u>Web Links</u>**

1. http://nptel.ac.in/courses/103107081/
2. http://nptel.ac.in/courses/103103029/
3. http://nptel.ac.in/courses/103107082/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE715 (Elective-I) | Petroleum refinery and petro-chemicals | 3 | 0 | 2 | 0 | 4 |

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

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

## Syllabus (Theory):

**UNIT I-Introduction:** World Petroleum resources, petroleum industry in India, origin, exploration, drilling, composition and classification of petroleum crude, ASTM, TBP and FEV and production of petroleum crude, transportation and pretreatment of crude oil.

**UNIT II-Distillation of crude oil:** Atmospheric and Vacuum distillation. Properties and specification of petroleum products-LPG, Gasoline, naphtha, kerosene, diesel oil, lubricating oil, wax etc. Testing and uses of petroleum products. Safety and pollution considerations in refineries

**UNIT III-Conversion process:** Thermal and catalytic in vapor, liquid and mixed phases, Hydrocracking, Thermal reforming, Polyforming and plat forming, Catalytic reforming

**UNIT IV-**Conversion of petroleum gases into motor fuel with reference to Alkylation, Polymerization, Isomerisation, Hydrogenation, Production of aviation gasoline, motor fuel, kerosene, diesel oil and jet fuel.

**UNIT V-Vacuum distillation:** Design and operation of topping and vacuum distillation UNITs. Tube still furnaces solvent extraction, uses of lubricating oils & waxes, Chemical & clay treatment of petroleum products, Desulphurization

**UNIT VI-Petrochemicals:** Classification of Petrochemicals, Ethylene, Propylene, Butylenes, Acetylene, Butadienes, Chloroprene, Cyclohexane, BTX. Synthesis gas, Methanol, Ethanol, EO, PO, IA, Acetone, Allyl alcohol, Glycerol, Acrylonitrile, Acrylic acid and Derivatives, Phenol, Aniline, Nylon Monomers, Polyester Monomers, Styrene, Other monomers, Plastics, Rubbers, Fibers, Resins, Detergents, Pesticides, Dyes, Protein, Explosives.

## Practical

1. Determination of viscosity of given petroleum fraction using saybolt viscometer.

2. Determination of vapour pressure of gasoline using Reid Vapour pressure apparatus.
3. Determination of Aniline Point of given petroleum fraction.
4. Determination of Smoke Point of Kerosene.
5. Determination of Flash and fire Point of given petroleum fraction using Abel's flash point apparatus.
6. Determination of Flash and fire Point of given petroleum fraction using Pansky Martene's apparatus.
7. Determination of Cloud and pour Point of given petroleum fraction.
8. Determination of Carbon Residue of given petroleum fraction using Rams Bottom Carbon Residue apparatus.
9. Determination of Calorific value of given petroleum fraction using Bomb Calorimeter.

**Textbooks:**

1. B.K. Bhaskara Rao, "Modern Petroleum Refining Processes", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 4th ed., 2002.
2. Maiti S., "Introduction to Petrochemicals", Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 2nd Ed., 2002.

**Reference Book:**

1. Nelson, W.L., "Petroleum Refinery Engineering", McGraw-Hill Kogakusha, Ltd., Tokyo, 4th ed., (International student edition), 1958.
2. Watkins, R.N., "Petroleum Refinery Distillation", Gulf Pub. Company, Houston, 2nd ed., 1979.
3. Gary, J.H and Handework, G.E., 'Petroleum Refining Technology and Economics', Fourth Edition, Marcel Dekker, Inc., 2001
4. Ram Prasad, 'Petroleum Refining Technology', First Edition, Khanna Publishers, 2013

**Web links:**

1. http://nptel.ac.in/syllabus/syllabus.php?subjectId=103102022
2. http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/Refinery20Process%20Design%20Notes_for%20IITG.pdf
3. NPTEL Courses on Refining available at http://nptel.ac.in/courses/103103029/pdf/mod2.pdf

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE512 ((Elective-I)) | Process Modelling and Simulation | 3 | 0 | 2 | 0 | 4 |

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

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

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

## Syllabus (Theory)

**UNIT I-Introduction**: Use and scope of mathematical modeling, Principles of model formulation, Role and importance of steady-state and dynamic simulation, Classification of models, Model building, Modeling difficulties, Degree-of-freedom analysis, Selection of design variables, Types of equations.

**UNIT II-Fundamental Laws:** Equations of continuity, energy, momentum, transport, and state, Transport properties, Equilibrium and chemical kinetics, Review of thermodynamic correlations for the estimation of physical properties like phase equilibria, bubble and dew points etc, Prediction of enthalpy departure and VLE characteristics from equation of state by the application of numerical methods.

**UNIT III-Modeling of Specific Systems:** Constant and variable holdup CSTRs under isothermal and non-isothermal conditions, Stability analysis, Gas phase pressurized CSTR, Two phase CSTR, Non-isothermal PFR, Batch and semi-batch reactors, Heat conduction in a bar, Laminar flow of Newtonian liquid in a pipe, Gravity flow tank, Single component vaporizer, Multi-component flash drum, Absorption column, Ideal binary distillation column and non-ideal multi-component distillation column, Batch distillation with holdup etc.

### Textbooks:

1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", McGraw-Hill 1998.

### Reference Books:

1. Denn, M. M., "Process Modeling", Longman Sc& Tech., 1987.

2. Himmelblau, D.M and Bischoff, K.B., "Process Analysis and Simulation: Deterministic Systems", John Wiley, 1968.
3. Holland, C. D., "Fundamentals and Modeling of Separation Processes: Absorption, Distillation, Evaporation and Extraction", Englewood Cliffs, Prentice-Hall, 1974.
4. Babu, B.V., "Process Plant Simulation", Oxford University Press, 2004.

**Web Links**

https://ocw.mit.edu/courses/materials-science-and-engineering/3-021j-introduction-to-modeling-and-simulation-spring-2012/

| **Course: Professional Communication CCT507** | | |
|---|---|---|
| **Course Description**<br>This course introduces students to the nuances of communicating professionally. It equips students to understand the need and demand for professional communication, especially in the context of work. Students will be able to speak, write (in different formats) and present professionally, and create their online presence through this course. | | |
| **Prerequisites** | | |
| **Hours per Week: 3 hours** | | **L-T-P: 2-1-0** |
| **Credits** | | **3** |
| **Sr. No** | **Specifications** | **Weightage (in percentage)** |
| 01 | Attendance | 10 |
| 02 | Assignment | 60 |
| 03 | Class Participation | 10 |
| 04 | Quiz | Nil |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam | Nil |
| 08 | Report-1 | 20 |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | Nil |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation | Nil |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus**

| **Units** | **Description** |
|---|---|
| Meaning of Professional Communication | Students are exposed to the difference as well as synergy between formal and informal communication<br>Through various scenarios and exercises, students are made to understand the meaning of professional communication |
| Introduction to Structure | Basic structure of communication is introduced to the students; they understand the significance and formulation of beginning, middle and end<br>Students are highlighted the use of the structure in different formats |

| | |
|---|---|
| Email Writing | Importance of writing professionally, especially through emails is established<br>Dos and Donts of email writing shared; students practice email writing |
| Article Review | Students are taught the need and use of reviews and forming an opinion about things they read<br>Format of crafting a review shared; practice of structured writing |
| Caselet Analysis | Students are introduced to analyse a Caselet and the format of writing the analysis in a structured format |
| Report Writing | Revision of Report Writing – purpose and format shared<br>Practice the art of professionally crafting reports through practice and activities |
| Presentation Skills (Design) | Students are exposed to basic principles of making a good PPTs and are introduced useful tools and software to be used to making good presentations<br>The importance of storytelling through presentations is explained |
| Presentation Skills (Delivery) | Detailed practice of different importance components of storytelling<br>Delivery – Overcome stage fear, work on body language<br>Content – Create story, Edit,<br>Voice - Voice modulation, enunciation, pronunciation |
| Professional Conversations | Students practice ways of professional conversations through various scenarios<br>Students are introduced to the art of handling difficult conversations |

| **Course Title and Code:** Process Equipment Design CHE603 | | |
|---|---|---|
| Hours per Week | | **L-T-P: 3-1-2** |
| Credits | | **5** |
| Students who can take | | **B.Tech Semester-VI (Batch: 2016-2020)/ Core** |

**Course Objective:** The aim of this course is to educate chemical engineering students about the materials and design methods for various process equipment.

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

1) Select appropriate materials and process parameters for chemical process equipment design as per international standards (IS: 803-1962; IS: 2851, 2825-1969).
2) Identify process design parameters for different types of chemical industry.
3) Design heat transfer and mass transfer equipment.
4) Design cooling and heating systems for batch and continuous stirred tank reactors.
5) Design main process equipment like storage vessels, vessel supports, heat exchanger, evaporator, condenser, agitators, distillation column, reaction vessel as well as auxiliary process vessels like a decanter, cyclone separator as per design and safety standard using software tools.

| **Prerequisites** | | Process calculations, Thermodynamics, Momentum Transfer, Mass Transfer, and Heat Transfer. |
|---|---|---|
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | 05 |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 05 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | 10 |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | 05 |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | 05 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**Course Syllabi (Theory):**

**INTRODUCTION**: Introduction to Chemical Engineering Design, Process design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards (IS, ASTM and BS)
**CRITERIA IN VESSEL DESIGN**: Properties of materials, Material of construction for various equipments and services, Material specifications, Fabrication techniques
**DESIGN OF PRESSURE VESSELS**: Design of pressure vessels under internal pressure, Construction features, Pressure vessel code, Design of shell, various types of heads, nozzles, flanges for pressure vessel, Design and construction features of thick-walled pressure vessels, various types of jackets and coils for reactors, Auxiliary process vessels
**SUPPORTS FOR VESSELS**: Design consideration for supports for process equipments, Design of brackets support, leg support skirt, support, saddle support.
**DESIGN OF STORAGE VESSEL**: Storage of nonvolatile and volatile liquids and gases, Codes for storage vessel design, Bottom, Roof and Shell designs.
**DESIGN OF VESSELS UNDER EXTERNAL PRESSURE**: Design criteria for external design pressure, vessels operated under vacuum, Use of stiffeners, Design of covers, pipes and tubes
**DESIGN OF HEAT EXCHANGER:** Types of heat exchangers, Selection criteria, Process design calculations for heat transfer equipment, Design of heat exchangers- shell, tube, baffles, closures, channels, tube sheets etc., estimation of heat transfer coefficients and pressure drop by Kern's and Bell's methods, consider design, plate type heat exchanger design.
**DESIGN OF DISTILLATION AND ABSORPTION COLUMN:** Basic features of tall vertical equipments/ towers, Towers/Column Internal, Design of tower shell and internals, supports etc.
**PROCESS HAZARDS & SAFETY, MEASURES IN EQUIPMENT DESIGN**: Equipment testing, Analysis of hazards, Pressure relief devices. Safety measures in process equipment design

**Syllabus (Practical)**

1. Design & drawing of Pressure Vessels
2. Design & drawing of Heat Exchangers
3. Design & drawing of Distillation Columns
4. Design & drawing of Reactors
5. Design & drawing of Storage Vessels
6. Design & drawing of specific equipments: Evaporators/ Crystallizers/ Dryers, etc.

7. Sketches of equipment accessories such as covers for pressure vessels, flanges, flange facing, supports, roofs for storage vessel, jackets, coils, tube sheet for heat exchangers, baffles in head exchangers, trays for distillation columns, packing for distillation towers, liquid distributors etc.
8. ChemCAD application in equipment design.

**Textbook:**


1. Bhattacharya, B.C., Introduction to Chemical Equipment Design, Mechanical Aspect, CBS Publishers and Distributers, 2009.
2. Sinnott Ray and Towler Gavin, Coulson and Richardson's Chemical Engineering series Chemical Engineering Design Volume6, 5$^{th}$ edition, 2013.
3. Kern, D.Q., Process Heat Transfer, International Student Edition, McGraw Hill, 2002.


**Reference Book**


1. Mahajani, V.V. and Umarji, S.B., Joshi's Process Equipment Design, 4$^{th}$ edition, Macmillan Publishers India Limited New Delhi, 2010.
2. I.S.: 803-1962, code of practice for design, fabrication and Erection of vertical mild steel cylindrical welded oil storage tanks.
3. I.S.: 2851-1969, Code for unfired pressure vessel.
4. Ludwig E.E., Applied process Design in Chemical and Petrochemical Plants Volume-II, III, Gulf Publishing Co., 1995.
5. Brownell, L.E., and Young, E.H. Process Equipment Design, Wiley India (P.) Limited, 2004.

| **Course Title & Code:** Chemical Reaction Engineering-II CHE 608 (Department Elective-II) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-0** |
| Credits | **3** |
| Students who can take | **B. Tech Semester-VI (Batch: 2016-2020)/ Departmental Elective** |

**Course Objective:** The goal of this course is to facilitate understanding about structure and kinetics useful in analyzing the rates of chemical reactions for heterogeneous reactions. The course also aims to impart knowledge about designing homogeneous and heterogeneous reactors.

**After course completion, the student will be able to:**

1. Select appropriate catalyst for different kind of reactions in the chemical process plants.
2. Identify preparation and characterization methods for different kind of catalysts used in the chemical industry.
3. Explain catalytic and non-catalytic reaction kinetic models to determine the rate of reaction.
4. Explain the effects of interpellant diffusion on reaction kinetic in isothermal pellets.
5. Compare the reaction kinetics for gas-solid and gas-liquid reactions.
6. Propose schemes to recycle and reuse energy generated during reaction kinetics.
7. Design homogeneous and heterogeneous reactors ensuring minimum wastage of catalyst following design and safety standards.

| | **Prerequisites** | Chemical Reaction Engineering-I |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | 05 |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 05 |
| 5 | Theory Exam-I | 20 |
| 6 | Theory Exam-II | 20 |
| 7 | Theory Exam-III | 40 |
| 8 | Report-I | Nil |
| 9 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | Nil |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | Nil |
| 15 | Lab Evaluation-II | Nil |
| 16 | Course Portfolio | Nil |

| | | |
|---|---|---|
| | **Total (100)** | **100** |

**Syllabus (Theory)**

**Catalysts:** Description, method of preparation and manufacture; catalyst characterization BET surface area, pore volume, pore size distribution.
**Catalyst Reaction Kinetic Models:** Physical and chemical absorption; determination of rate expressions using absorption, surface reaction and desorption as rate-controlling steps.
**Determination of Global Rate of Reaction**: Heterogeneous laboratory reactors; Determination of rate expressions from experimental data.
**Effect of Intrapellet Diffusion on Reaction Rates in Isothermal Pellets:** Concept of effectiveness factor, Thiele modulus, experimental determination of effectiveness factor-wesiz-Prater criteria, Non-Isothermal effectiveness factor; Prater number, maximum temperature rises in a pellet, multiple steady states in heterogeneous reactors.
**Non-catalytic Gas-Solid Reactions**: Progressive conversion model, shrinking core model; various controlling regimes, design of gas-solid reactors.
**Gas-Liquid Reactions:** Effect of diffusion on rate of reaction, enhancement factor.
**Introduction to Design of Heterogeneous Reactors**: One dimensional model for fixed-bed reactors, parametric sensitivity; design of fluidized bed reactors

**Textbooks**

1. Smith, J.M., Chemical Engineering Kinetics, 3rd Ed., Mc Graw-Hill, 1981.
2. Levenspiel, O., Chemical Reaction Engineering, 3rd Ed., John Wiley, 1999.

**Reference books**

1. Dawande, S.D., Principals of reaction engineering, central techno Pub., Nagpur, 2001.
2. Carberry, J.J., Catalytic reaction engineering, Mc Graw Hill, 1976.
3. Davis, M.E., Davis, R.J., Fundamentals of Chemical Reaction Engineering, Mc. Graw Hill.
4. Fogler H.S., Elements of Chemical Reaction Engineering, Prentice Hall Publication.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CHE734 (Department Elective-II) | Regulations of Health, Safety and Environment | 3 | 0 | 0 | 0 | 3 |

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

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

## Syllabus (Theory):

**UNIT I:** Factories act and rules; Workmen compensation act.
**UNIT II:** Indian explosive act - Gas cylinder rules - SMPV Act - Indian petroleum act and rules. Environmental pollution act
**UNIT III:** Manufacture, Storage and Import of Hazardous Chemical rules 1989
**UNIT IV:** Indian Electricity act and rules.
**UNIT V:** Overview of OHSAS 18000 and ISO 14000

## REFERENCES:


1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
5. Explosive Act, 1884 and Explosive rules, 1883 (India), (2002), Eastern Book company, Lucknow, 10th Edition
6. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
7. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria & Sons, Delhi


## Web Links

1. https://www.osha.gov/dte/edcenters/certificate_listing.html

<table>
<tr><td colspan="3">Course Title and Code: Computational Fluid Dynamics ME639 (Open Elective-I)</td></tr>
<tr><td colspan="2">Hours per Week</td><td>L-T-P: 3-0-2</td></tr>
<tr><td colspan="2">Credits</td><td>4</td></tr>
<tr><td colspan="2">Students who can take</td><td>B. Tech Semester-VI (Batch: 2016-2020)/Elective</td></tr>
<tr><td colspan="3">Course Objective:<br>1. Equip students with the knowledge base essential for application of computational fluid dynamics (CFD) to engineering flow problems<br>2. Provide the essential numerical background for solving the partial differential equations governing the fluid flow<br>3. Develop students' skills of using a commercial software package (ANSYS Fluent)</td></tr>
<tr><td colspan="3">After course completion, the student will be able to:<br>1. Use CFD tool to simulate the fluid flow and heat transfer phenomena in design and predict the system performance before manufacturing.<br>2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same.<br>3. Evaluate different flow computation methods and make appropriate choice.<br>4. Model flow problem properly within CFD context, using CAD package and meshing tool as per ASTM standards.<br>5. Use CFD software to model relevant engineering flow problems, postprocessing of the CFD results, compare with available data, and explain the findings.</td></tr>
<tr><td></td><td>Prerequisites</td><td>Fluid Mechanics and Heat Transfer</td></tr>
<tr><td>Sr. No</td><td>Specifications</td><td>Marks</td></tr>
<tr><td>1</td><td>Attendance</td><td>Nil</td></tr>
<tr><td>2</td><td>Assignment (4)</td><td>10</td></tr>
<tr><td>3</td><td>Class Participation</td><td>5</td></tr>
<tr><td>4</td><td>Quiz</td><td>5</td></tr>
<tr><td>5</td><td>Theory Exam-I</td><td>Nil</td></tr>
<tr><td>6</td><td>Theory Exam-II</td><td>20</td></tr>
<tr><td>7</td><td>Theory Exam-III</td><td>30</td></tr>
<tr><td>8</td><td>Report-I</td><td>Nil</td></tr>
<tr><td>9</td><td>Report-II</td><td>Nil</td></tr>
<tr><td>10</td><td>Report-III</td><td>Nil</td></tr>
<tr><td>11</td><td>Project-I</td><td>20</td></tr>
<tr><td>12</td><td>Project-II</td><td>Nil</td></tr>
<tr><td>13</td><td>Project-III</td><td>Nil</td></tr>
<tr><td>14</td><td>Lab Evaluation-I</td><td>10</td></tr>
<tr><td>15</td><td>Lab Evaluation-II</td><td>Nil</td></tr>
<tr><td>16</td><td>Course Portfolio</td><td>Nil</td></tr>
<tr><td></td><td>Total (100)</td><td>100</td></tr>
</table>

**Syllabus (Theory):**

**Introduction** to Computational Fluid Dynamics and Principles of Conservation: Computational Fluid Dynamics: What, When, and Why? CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation. The impact of CFD. The governing equations of fluid dynamics- models of the flow, The substantial derivatives, continuity equation, momentum equation, Energy equation, boundary conditions

**Mathematical behavior of partial differential equa**tions- Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations

**Basic aspect of discretizations**- Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term

**Finite Volume Method** - Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions

**Discretization of Convection-Diffusion Equations**- A Finite Volume Approach: Finite volume discretization of convection-diffusion problem: Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, Finite volume discretization of two-dimensional convection-diffusion problem, The concept of false diffusion, QUICK scheme.

**Discretization of Navier Stokes Equations**: Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm

**Practical:**

Interface with software, Simulation-1 Pipe flow, Meshing + BC, Simulation-2 Sudden Enlargement in c/s, Solver setting, Simulation-3 Flow around a vehicle, Full processing and post processing, Simulation-4 Fin Heat transfer

**Textbooks:**

1. PS Ghoshdastidar. "Computational Fluid dynamics and Heat transfer", Cengage
2. J. D. Anderson Jr. "Computational Fluid Dynamics" McGraw-Hill International Edition.
3. S.V. Patankar "Numerical Heat Transfer and Fluid Flow" Hemisphere
4. H.K. Versteeg and W. Malalasekera "An introduction to computational fluid dynamics: The finite volume method" Pearson Education

| Course Title and Code: Electrical Safety (EE611) (Open Elective-I) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-0** |
| Credits | **3** |
| Students who can take | **All B. Tech Students** |

**Course Objective:**

The goal of this course is to discuss electrical hazards, Safety standards, protection issues, identification of sensors for protection and develop understanding of the CEA regulations for Electrical safety. This course will facilitate students to find solutions of electrical hazards.

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

1. Identify the hazards associated with electricity: shock and fire.
2. Investigative the cause of electrical accidents and fires.
3. Identify and explain how to respond to electrical emergencies.
4. Identify safe work practices when exposed to electrical hazards (including risk assessment)
5. Apply the acts in accordance with the risk and safety issues, legal obligations codes of safety practice.
6. Explain the Indian electricity safety code and rules
7. Plan and take measures to minimize hazards
8. Formulate the suitable methodologies to determine safety risks in relevant practical applications.
9. Review the design of existing electrical systems as per the standard electrical safety code.
10. Integrate the sensors for the monitoring and automation of electrical systems.

| **Prerequisites** | | Basics of Electrical Engineering, |
|---|---|---|
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | - |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | 10 |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | 05 |
| 9 | Report-II | 05 |
| 10 | Report-III | - |
| 11 | Project-I | 10 |
| 12 | Project-II | 10 |
| 13 | Project-III | - |

| | | |
|---|---|---|
| 14 | Lab Evaluation-I | - |
| 15 | Lab Evaluation-II | - |
| 16 | Course Portfolio | - |
| | **Total (100)** | 100 |

## Syllabus (Theory)

**UNIT I: Concepts and Statutory Requirements**

Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference –Working principles of electrical equipment -Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety –first aid-cardiopulmonary resuscitation (CPR).

**UNIT II: Electrical Hazards**

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation –earthing, specifications, earth resistance, earth pit maintenance.

**UNIT III: Protection Systems**

Fuse, circuit breakers and overload relays –protection against over voltage and under voltage –safe limits of amperage –voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment –safety in handling handheld electrical appliances tools and medical equipments.

**UNIT IV: Selection, Installation, Operation and Maintenance**

Role of environment in selection-safety aspects in application -protection and interlock-self diagnostic features and fail-safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.

**UNIT V: Hazardous Zones**

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

**Reference Books:**


1. Mary Capelli-Schellpfeffer, Dennis Neitzel, John Cadick, Al Winfield, "Electrical Safety Handbook" McGraw-Hill Education.
2. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards" CRC Press.
3. Krishnan, N.V., Safety Management in Industry, Jaico Publishing House,
4. Cooper W.F., Electrical Safety Engineering, Newnes.
5. Cadick, J., et. al., Electrical Safety Handbook, McGraw Hill Education.
6. Bureau of Indian Standards, National Electrical Code 2011, Bureau of Indian Standards, New Delhi, 2011.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE480 | Industrial IoT | 3 | 0 | 2 | 0 | 3 |

**Course Objective**: This course is an introduction to the key components that make up an Industrial IoT system. Good practices, protocols and standards employed at each layer of the IIoT stack are introduced.

**Learning Outcomes:**

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

1. Explain the key components that make up an Industrial IoT system and differentiate between Internet of Things (IoT) and Operational Technology (OT).
2. Discuss protocols and standards employed at each layer of the IIoT stack.
3. Design, deploy and test a basic Industrial IoT system, including data analysis functionalities.
4. Apply best practices in order to meet desired requirements for IIoT applications.
5. Analyze the environmental effects and incorporate robustness in design of IIoT system.
6. Choose technology for constrained nodes and network while maintaining real time data collection.
7. Explain the importance of cybersecurity for IIoT networks

**Assessment Scheme**

| Sr. No | Specifications | Marks |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignment | Nil |
| 03 | Class Participation | Nil |
| 04 | Quizzes | 15 |
| 05 | Theory Exam-I | 20 |
| 06 | Theory Exam-II | Nil |
| 07 | Theory Exam-III | 30 |
| 08 | Report -1 | Included with Project 1 |
| 11 | Project -1 | 20 |
| 15 | Lab Evaluation | 15 |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Course Syllabus**

**Unit 1 IoT Fundamentals**

IoT definition. Opportunities and challenges. Characteristics. Physical and logical design. Protocols. Security and safety. Use cases.

**Unit 2 IIoT Fundamentals**

Industrial communication: principles, protocols and technologies. IIoT definition, architectures and use cases. Convergence of IT and OT. Design methodology.

**Unit 3 HMI and SCADA systems**

Elements of HMI and SCADA systems. Typical architecture. Life cycle. Standards.

**Unit 4 Data Analytics**

Basic concepts and technologies. Applications: Predictive maintenance. Smart factories. Smart transportation.

**Practical work:** Design and test a basic IIoT system involving prototyping, programming and data analysis.

**Textbooks:**

1. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach. Vpt, 2014.
2. Hanes, David, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things. Cisco Press, 2017.

**Reference book:**

1. Gilchrist, Alasdair. Industry 4.0: the industrial internet of things. Apress, 2016.

**Course Title and Code**

Computing with SAS: CSE429 (Open Elective -I)

| | |
|---|---|
| Hours per Week | **L-T-P: 1-0-4** |
| Credits | **3** |
| Students who can take | B.Tech Sem IV and Sem VI Students (All Branches) |

**Course Objective:** The aim is to introduce fundamental SAS programming language for use in data with focus on descriptive statistics.

**Learning Outcome:**

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

1. Describe statistical terms and symbols as per ISO standard ISO-3534.
2. Import/export, clean/process and transform data (e.g. Air quality dataset, Crime against woman dataset, Solar energy Dataset etc.) using SAS functions and programming statements.
3. Perform descriptive statistics using SAS procedures.
4. Write and debug the scripts, macros and programs with SAS system.
5. Analyze and interpret given data statistically as per ISO standard (ISO 5479, ISO 11453, and ISO 16269).
6. Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
7. Apply computing theory and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
8. Interpret data findings to any audience, orally, visually and in written formats.

| Prerequisites | | |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | 20 |
| 03 | Class Participation | 10 |
| 04 | Quiz | 20 |
| 05 | Theory Exam-I | Nil |
| 06 | Theory Exam-II | Nil |
| 07 | Theory Exam-III | Nil |
| 08 | Report-I (Case Study) | 05 |
| 09 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 25 |
| 12 | Project-II | Nil |

| | | |
|---|---|---|
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | 20 |
| 15 | Lab Evaluation-II | Nil |
| 16 | Course Portfolio | Nil |
| | **Total (100)** | 100 |

## Syllabus (Theory)

UNIT I: Data Structures: Introduction to SAS interface and library structure and definition, reading data using Datalines and importing and exporting datasets, Infiles statement - reading raw data, Formats and Informats, Variable attributes and data modification using Data and Set statements

UNIT II: Data Management: Using conditional statements to modify data - Where, If and Nested If, Appending and Merging datasets, SAS Functions for data manipulation, Loops and Arrays in SAS,

UNIT III: Report Generation: Basic Proc steps - like Proc Contents, Proc Format, Proc Report and Proc Tabulate, proc steps for basic statistics - like Proc Univariate and Proc Means

UNIT IV: Proc SQL: Introduction to SQL - basic DBMS and RDBMS concepts, Using SQL Procedures in SAS, using conditional statements in SQL and aggregate functions, Data manipulation using Proc SQL

UNIT V: SAS Macros: Introduction to Macros, Local and Global declarations, Using built-in macro procedures and functions

**Reference Books**


1. Delwiche, Lora D., and Susan J. Slaughter. The little SAS book: a primer. SAS Institute, 2012.
2. Elliott, Alan C., and Wayne A. Woodward. SAS Essentials: Mastering SAS for Data Analytics. John Wiley & Sons, 2015.
3. Cody, Ron. Learning SAS by example: a programmer's guide. SAS Institute, 2018.

<table>
<tr><td colspan="3">Course Title and Code<br>Enterprise Programming Using Java: CSE428 (Open Elective -I)</td></tr>
<tr><td colspan="2">Hours per Week</td><td>L-T-P: 2-0-2</td></tr>
<tr><td colspan="2">Credits</td><td>3</td></tr>
<tr><td colspan="2">Students who can take</td><td>B.Tech Sem IV and Sem VI Students (All Branches Except IBM Students)</td></tr>
<tr><td colspan="3">Course Objective: This course introduces concepts of Enterprise Application Development, Advance Java Applications-using Server-Side Programming with the help of technologies like JSP, JDBC, Servlets and Spring Framework.</td></tr>
<tr><td colspan="3">Learning Outcome:<br>On successful completion of this course, the students should be able to:<br>1. Name and apply some common object-oriented design patterns and give examples of their use.<br>2. Write programs in Core JAVA.<br>3. Design, develop and debug software applications taking into account coding and documentation standards.<br>4. Apply concepts like multithreading, interfaces, generics in Java program design and implementation.<br>5. Design and create web based and other applications using practices of object-oriented concepts.<br>6. Use java collection API.<br>7. Evaluate different integrated development environment e.g. NetBeans, Eclipse with respect to creation and debugging Web Driver and Web Server of enterprise-level applications.<br>8. Use JDBC API for database-independent connectivity between the Java programming language and MySQL database.<br>9. Develop server-side solution using Servlet and JSP technologies (J2EE).<br>10. Design, develop, and debug web applications using Aspect oriented Programming using Spring Framework.<br>11. Use energy saving programming practices.</td></tr>
<tr><td colspan="2">Prerequisites</td><td>C++</td></tr>
<tr><td>Sr. No</td><td>Specifications</td><td>Marks</td></tr>
<tr><td>01</td><td>Attendance</td><td>Nil</td></tr>
<tr><td>02</td><td>Assignment</td><td>10</td></tr>
<tr><td>03</td><td>Class Participation</td><td>5</td></tr>
<tr><td>04</td><td>Quiz</td><td>5</td></tr>
<tr><td>05</td><td>Theory Exam-I</td><td>10</td></tr>
<tr><td>06</td><td>Theory Exam-II</td><td>20</td></tr>
</table>

| | | |
|---|---|---|
| 07 | Theory Exam-III | Nil |
| 08 | Report-I | Nil |
| 09 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 30 |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | 20 |
| 15 | Lab Evaluation-II | Nil |
| **16** | Course Portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory)**

**UNIT I** – Object Oriented Programming Concepts-Java, JRE, JVM & JDK, Operators, Methods, Keywords, Control Structures, Method Overloading & Overriding, Input using Command Line Arguments & Scanner, Constructors, Finalizer(), Garbage Collection, Strings, Access Modifiers, Inner Classes, Cloning Objects, Abstract Classes, Interfaces, Packages, UTIL Package, File I/O using java.io package

**UNIT II** - Exception Handling: The Idea behind Exception, Exceptions & Errors, Types of Exceptions, Control Flow in Exceptions, Multi-Threaded Programming, Thread Lifecycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads, Multithreading in JAVA.

**UNIT III** – JDBC Programming - The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, Updating Database Data, Error Checking and the SQL Exception Class, The SQL Warning Class, The Statement Interface, Prepared Statement, Callable Statement The Result Set Interface, Updatable Result Sets, JDBC Types, Executing SQL Queries, Result Set Meta Data, Executing SQL Updates, Transaction Management. Servlet API & Overview - Servlet Model: Overview of Servlet, Servlet Life Cycle, HTTP Methods Structure & Deployment descriptor Servlet Context & Servlet Config interface, Attributes in Servlet, Request Dispatcher interface The Filter API: Filter, Filter Chain, Filter Config Cookies and Session Management: Understanding state and session, Understanding Session Timeout and Session Tracking, URL Rewriting

**UNIT IV**–Java Server Pages (JSP) - JSP Overview: The Problem with Servlets, Life Cycle of JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP

Environment, JSP Directives, JSP Action, JSP Implicit Objects JSP Form Processing, JSP Session and Cookies Handling, JSP Session Tracking JSP Database Access, JSP Standard Tag Libraries, JSP Custom Tag, JSP Expression Language, JSP Exception Handling, JSP XML Processing.

**UNIT V** – Java Web Frameworks: Spring MVC Overview of Spring, Spring Architecture, bean life cycle, XML Configuration on Spring, Aspect Oriented Programming - Spring, Managing Database, Managing Transaction.

***NOTE:* Integrated Development Environments (IDEs) to be used in this Course are Eclipse or NetBeans – Both are compatible for Enterprise Programming using Java.**

**Reference Books**


1. Savaliya, M.T. ADVANCED JAVA. Revised ed. Dreamtech Press, 2017. ISBN: 978-93-5119-934-2.
2. Roy, Uttam K. Web Technologies. Oxford University Press, 2010.
3. Matha, Mahesh P. JSP and Servlets – A Comprehensive Study. Revised Edition ed. PHI Learning Pvt., 2013.ISBN-978-81-2034745-8.

| **Course Title and Code**<br>Cyber Security: CSE601(Open Elective -I) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | **3** |
| Students who can take | B.Tech Sem IV and Sem VI Students (All Branches Except B.Tech CSE IBM (IS Specialization) |

**Course Objective:** This course introduces the concepts, techniques and tools of cyber security: like network packet scanning, firewalls, IDS and IPS etc.

**Learning Outcome:**

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

1. Analyse computer systems' various security challenges using Vulnerability-Threat-Control Paradigm.
2. Program and apply some classical Cryptographic Algorithms.
3. Differentiate between various types of malwares – viz., viruses, worms, trojans etc.
4. Identify and classify client-side web access threats due to browser vulnerabilities.
5. Use various network security, packet capturing and intrusion detection software like Wireshark, Nmap etc.
6. Create some simple viruses using C programming and deploy them.
7. Use Kali Linux-Distro (O.S.) and some of its embedded software tools with ease.
8. Carry Out Simple Penetration Tests – How to be a White Hat?
9. Apply appropriate Identification and Authentication mechanisms for access control of computing resources.
10. Design and Deploy Simple Software firewalls.
11. Compare features of secure version of TCP/IP protocols with classical ones.
12. Describe and analyze the Ethical Hacking Standards defined by EC-Council and apply them in projects.
13. Apply the Secure Coding Practices as defined by CERT.
14. Describe and apply various cyber-security standards as defined by NIST, ETSI, ISO/IEC etc. using case studies.
15. Analyze various cyber-security laws related to cyber-bulling, hacking, cyber-fraud etc. in a global context.

| Prerequisites | | **Nil** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignments | 15 |
| 03 | Class Participation | 5 |
| 04 | Quiz | 10 |
| 05 | Theory Exam | 15 |

| | | |
|---|---|---|
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | 25 |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 30 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2(Final) | Nil |
| **16** | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory)**

**UNIT I:** Introduction to Cyber Security: - Need for Cyber Security, Vulnerability – Threat – Control Paradigm, Cyber threats of various kinds, Introduction to Computer Networks and its terminology, IP Address/Sub-Netting, Important Principals of Cyber Security, Different kinds of cyber threats. Business Needs -Threats and Countermeasures – Attackers - Policies and Standards - Legal, Ethical and Professional Issues. AAA-Standard. Introduction to Various Organizations and Standards related to Computer Networks and Security. OSI Layer Model and the TCP/IP model. Introduction to Penetration Testing – How to be a White Hat

**UNIT II:** Introduction to Cryptography: Some History of Cryptography, Classical Cryptography Schemes and Algorithms (Encryption and Decryption), Symmetric or Public Key Cryptography and its common algorithms – DES, AES etc., Asymmetric or Private Key Cryptography and its most common algorithm – RSA. Introduction to Steganography. Hashing Techniques – MAC, HMAC etc. Digital Signature Algorithms. Certifying Authorities (CAs). Introduction to End-to-End Encryption. Introduction to Cryptanalysis.

**UNIT III:** Introduction to Network Security: Securing Network Transmission - Analyzing Security Requirements for Network Traffic -Defining Network Perimeters -Data Transmission Protection Protocols. Common attacks on Computer Networks & networks in general – Introduction to Network Scanning/Monitoring software like Wireshark, Nmap etc. Intrusion Detection - Detection and Prevention -Honeypots, Honeynets. Scanning and Analysis Tools -Biometric Access Controls – Forensics -Incident Response Procedures

**UNIT IV:** Introduction to Application Security: Web Browser Security - Email Security – Firewall – VPN - Transport Layer Security (TLS) – Handshake Protocol – Alert Message Protocol – Change Cipher Spec Protocol – Secure Electronic Transfer Protocol (SET) – IPsec – HTTPS – SSL. Disaster Recovery and Fault Tolerance. Planning for the Worst -Creating a Backup Strategy -Designing for Fault Tolerance – Antivirus Software – Antivirus Features – Typical signature - Byte-Streams – Checksums - Custom Checksums - Cryptographic Hashes Advanced Signatures - Fuzzy Hashing

**UNIT V:** Cyber Crimes and Cyber Laws: Various types of Cyber Crimes - Cyber privacy – Crimes against property – Crimes against the Person- Crimes against the State- Crimes against the computer network- Financial Crimes; Information Technology Act, 2000 - Outline of the Act- Aims and Objectives of the Act- Applicability of the Act; Types of Jurisdiction – Jurisdiction for Internet cases -Territorial Jurisdiction and Cyber Space – Minimum Contacts theory and Purposeful Availment theory – French Yahoo case, Dow Jones case- IT Act on Jurisdiction. Cyber Crime Cells – Law Enforcement.

**Reference Books**


1. Vacca, John R. Computer and information security handbook. Newnes, 2012.
2. Ciampa, Mark. Security+ guide to network security fundamentals. Cengage Learning, 2012.
3. Stallings, William. Cryptography and Network Security, 4/E. Pearson Education India, 2006.
4. Kamath Nandan, "Law Relating to Computers Internet & E-commerce (A Guide to Cyber laws & the Information Technology Act, Rules, Regulations and Notifications along with Latest Case Laws)", 2012, Universal Law Publishing, 2016
5. S.K. Verma and Raman Mittal, "Legal Dimensions of Cyber Space", Universal Law Publishing, 2004
6. Sachin Rastogi, "Insights into E - Contracts in India", LexisNexis, Ist Edition, 2013
7. Karnika Seth, "Computers, Internet and New Technology Laws", LexisNexis, 2013
8. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015. ISBN: 78-1-4822-3161-8.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| MA406 (Open Elective-I) | Random Variables and Stochastic Processes | 3 | 1 | 0 | 4 |

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

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

## Syllabus (Theory)

**Unit 1: PROBABILITY**
Introduction, definitions, conditional probability, combined experiments.

**Unit 2: RANDOM VARIABLES**
Introduction, Distribution and density functions, Discrete and continuous random variables, (Gaussian), Exponential, Rayleigh, Uniform, Bernoulli, Binominal, Poisson, discrete Uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.

**Unit 3: MULTIPLE RANDOM VARIABLES**
distributions, function of two random variables, Two functions of two random variables, Joint moments, Joint characteristics functions, Conditional distribution s, conditional expected values, statistical independence. Multiple random variables: multiple functions of multiple random variables, jointly Gaussian random variables, sums of random variable, Central limit theorem.

**Unit 4: STOCHASTIC PROCESSES**
Definitions, Random process concept, Statistics of stochastic processes: mean, auto correlation, strict and wide sense stationary, random processes and Linear Systems.

**Unit 5: STOCHASTIC PROCESSES IN FREQUENCY DOMAIN**
Power spectrum of stochastic processes, Transmission over LTI systems, Gaussian and White processes, Properties of power spectral density.

## Textbooks and Reference books


1. Probability, Random Variables and Stochastic Processes, Papoulis, TMH (2002)
2. Stochastic Processes, 2ed, Ross, Wiley. (1996)
3. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing,'' Third Edition, Pearson Education. (Indian Edition is available).
4. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes,'' Fourth Edition, McGraw Hill. (Indian Edition is available).

5. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International Student Edition.
6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.
8. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| MA601 (Open Elective-I) | Transform Calculus for Engineers | 3 | 0 | 0 | 3 |

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

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

**Syllabus (Theory)**

**Unit 1: Introduction**

Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-tooth wave, Euler's formulae, Complex exponential form for Fourier series, Half- and Quarter-Range Expansions

**Unit II: Fourier Integral and transform**

Fourier Integral, Fourier Transform, Transition from Fourier integral to Fourier Transform, Properties and applications, Characterization of Fourier transform - Paley-Wiener theorems.

**Unit III: Discrete Fourier Transform**

Discrete Fourier transform, Fast Fourier Transform (FFT), Short-time Fourier transform (STFT): Definition and Interpretations, General Properties. Wigner-Ville transform (WVT), properties of WVD.

**Unit IV: Wavelet Transform**

Continuous wavelet transforms. Time-frequency resolution. Discrete wavelet transforms.

**<u>Textbooks and Reference books</u>**


1. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003). This book deals with mainly Fourier series.
2. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).
3. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc
4. R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesley, 1998.
5. L. Prasad & S.S. Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| PH601 (Open Elective-I) | Applications of Nanotechnology | 3 | 0 | 0 | 0 | 3 |

| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | |
|---|---|---|---|---|---|---|---|---|
| Mid Term Test – I | Mid Term Test - II | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks | Mid Term Test - I | End Term Test | Class Participation/ Additional Continuous Evaluation* | Total Marks |
| 20 | 20 | 40 | 20 | 100 | 20 | 50 | 30 | 100 |

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

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

## Course Description:

This course will help students to implement concept of the nanotechnology into various applications which directly or indirectly improving every one's lifestyle. This course will let students know the basic concept, fabrication process and scope for improvement of nano-transistors, PV Cells, energy storage devices, and nano-sensors.

## Syllabus (Theory):

### Nano-transistors

Introduction, ion implantation, epitaxial growth, diffusion, oxidation, wafer doping and etching, photolithographic processing, ultra-purification, MOSFET, Hetero junction BJT.

### Photovoltaic Cells

Introduction to Photovoltaic Cell/Solar Cell and It's Principles, Theory of Solar Cells, Series and parallel operation, Material, Thin film organic/inorganic photovoltaic cell, fabrication technologies of solar cells, fabrication of metal contacts, different device configuration of PV cell, conversion efficiency, efficiency limiting factors, power, spectral response, fill factor, Effect of Parasitic resistance, irradiation and temperature effect on I-V characteristics.

### Energy storage devices

Overview, Components and Classification of Batteries, Development, Principle, and applications of Lithium Batteries, Components of Rechargeable Lithium Batteries; Insertion electrode materials, cathode materials, anode materials, electrolytes, other components, Issues and challenges for cathode materials; nano crystallinity in cathode materials, metal ion doping in cathode materials, surface modified cathode materials.

### Nano-sensors:

Introduction of nano-sensors and nano-sensing system, future scope of sensors in industries, future requirements of nanotechnology in sensing, Enhancement of sensitivity and specificity, Chemical Sensor, Gas Sensors, Piezoelectric Sensor, Photo-sensors.

**Pre-requisite:**

Knowledge of basic science and nanotechnology

**Reference Books:**


1. Nanoscience and Nanotechnology, M.S. Ramachandra Rao, Wiley, 2016
2. Charles Poole and Frank Owens, Introduction to Nanomaterials, Wiley 2007
3. Nanotechnology: Principles and Practices, Sulbha Kulkarni, Springer 2015
4. Handbook of Nanotechnology, Bharat Bhusan, Springer 2017
5. Nano-technology- Molecularly Designed Materials, G. M. Chow & K. E. Gonsalves, (American Chemical society).
6. Nanofabrication: Principles, Capabilities and limits, Zheng Cui, Springer (India) Pvt. Ltd.

| **Course Title and Code:** Advance Course in Entrepreneurship: IM411, **(Open Elective-I)** | |
|---|---|
| Hours per Week | **L-T-P: 3-0-0** |
| Credits | **3** |
| Students who can take | B.Tech VI Sem. (All Branches) and BBA/B. Com (IV Sem.) |
| Course Requirement | Complete with Basic Course in Entrepreneurship and access to LearnWise™ platform |

**Course Overview:**

This course is the second of a two-part entrepreneurship development curriculum from Wadhwani Foundation. This course aims to teach the necessary skills to develop ventures beyond the idea/prototype stage. In this course, students will learn how to achieve sustainable growth by pivoting, refining business models, and business planning.

**Learning Outcomes:**

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

1. Refine business models and expand customer segments.
2. Design business plan for the venture.
3. Explore and develop the strategies to grow revenue and market.
4. Understand funding process and what investor look for.
5. Learn to build an A- Team.
6. Develop brand strategy and channel strategy for customer outreach.
7. Understand the key metrics to measure & track the venture progress.
8. Select the right type of legal form of the venture and understand the legal issues related to it.

| Sr. No | Specifications | Marks |
|---|---|---|
| 01 | Attendance | N.A. |
| 02 | Assignment | 15 |
| 03 | Class Participation | N.A. |
| 04 | Quiz/case study | 5 |
| 05 | Theory Exam-I | N.A. |
| 06 | Theory Exam-II | 20 |
| 07 | Theory Exam-III | 30 |
| 08 | Report-I | N.A. |
| 09 | Report-II | N.A. |
| 10 | Report-III | 15 (Final assessment on Learnwise) |
| 11 | Project-I | 15 |

| | | |
|---|---|---|
| 12 | Project-II | N.A. |
| 13 | Project-III | N.A. |
| 14 | Lab Evaluation-I | N.A. |
| 15 | Lab Evaluation-II | N.A. |
| 16 | Course Portfolio | N.A. |
| | **Total (100)** | 100 |

**Syllabus:**

Recap and Review the Fundamentals, Refining the Business Model and, product/Service, Business Planning, Exploring Ways to Increase Revenue, Funding the Growth, Building the A-Team, Creating a Branding and Channel Strategy, Leveraging Technologies and Available Platforms, Measuring Your Progress, Legal Matters, Seeking Support, Final Project Presentation.

**References:**


1. Robert D Hisrich, Michael P Peters, Dean A Shepherd (2012). **Entrepreneurship**. New Delhi; Tata McGraw-Hill.
2. Poornima M Charantimath (2012). **Entrepreneurship Development Small Business Enterprises**. New Delhi: Pearson.
3. Rajeev Roy (2011). **Entrepreneurship**. New Delhi: Oxford
4. Learnwise.org

| **Course Title and Code**<br>Critical Interpretation of Literature and Cinema: HS401 (Open Elective-I) | |
|---|---|
| Hours per Week | **L-T-P: 3 0 0** |
| Credits | **3** |
| Students who can take | **B. Tech Semester-IV (Batch: 2017-21) and Semester-VI (Batch: 2016-20) / Elective** |

**Course Objective:**

This course is designed to familiarize the students with various literary approaches to appreciate a literary text and expand the literary and cultural knowledge of students in relation to well-known literary texts and their film adaptations.

**Learning Outcomes:**

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

1. Critically analyze literary texts using classical (Plato, Aristotle, Dryden etc.) and contemporary (Sigmund Freud, Carl Jung, Elaine Showalter) literary approaches.
2. Connect a work of fiction to its film adaptation or to a cultural phenomenon and historical event.
3. Identify similarities and differences between film art and various literary genres.
4. Apply various literary devices and cinematic techniques to analyze literature and cinema respectively.
5. Compare and contrast various films in terms of their narrative form, style and visual language.

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

**Syllabus:**

Significance of Literature and Cinema

Interpreting Literature through Devices such as Narrative Technique, Theme, Plot, Action, Characterization, Structure, Unity, Stylistic Features, Figures of Speech such as Simile, Metaphor, Alliteration, Personification, Paradox, Antithesis, Oxymoron, Onomatopoeia, Hyperbole, etc.

Interpreting Cinema through Devices such as Theme, Story and Screenplay, Characteristics, Semiotics, Cinematography and Editing - Time and Space, Narrative, Lighting Sound/Music etc.

Feature Films and Short Films, Documentaries, History of Indian Cinema, actors and personality, cults, mythological films, major turning points and trends in cinema, Parallel cinema in India.

Film Review, Discussions & Presentations on various aspects of Cinema and Literature

Analyzing Selected Poems, Short Stories, Plays and Works of Fiction

List of Selected Works: Poems by Robert Frost, Alexander Pope, Short Stories by Chekhov, Katherine Mansfield, and Somerset Maugham; John Osborne's Look Back in Anger, Jhumpa Lahiri's The Namesake

**References:**

1. Beaver, Frank Eugene, A Dictionary of Film Terms: The Aesthetic Companion to Film Art. New York: Peter Lang, 2006.
2. Bluestone, George, Novels into Films. California: University of California Press, 1957.
3. Hood, John W, The Essential Mystery: Major Film Makers of Indian Art Cinema, Hyderabad: Orient Blackswan, 2009.
4. Hutcheon, Linda, A Theory of Adaptation. Second Ed. New York: Routledge, 2013

| **Course Title and Code**<br>Personal Branding & Workplace Communication: CCT601, **(Open Elective-I)** | |
|---|---|
| Hours per Week | **L-T-P: 2-0-0** |
| Credits | **2** |
| Students who can take | **B. Tech Semester-VI (Batch: 2016-20)** |
| Prerequisites | **N/A** |

**Course Objective:**

This course helps students to identify and craft their personal brand to face the potential employer and prepare them for the workplace.

**Learning Outcomes:**

The students will be able to:

1. Identify their brand, craft their brand statement and articulate their brand, using their strengths.
2. Create standout resumes and cover letters.
3. Craft an influential pitch and express their professional journey.
4. Perform well in GDs and Interviews.
5. Identify and correct common communication errors for better branding.
6. Create strong brand on social media platforms like LinkedIn, Job Portals, Facebook and Twitter.
7. Start building their professional network (online and offline) by identifying their areas of interest and use communication skills to connect with and maintain their networks.

| Sr. No | Specifications | Weightage |
|---|---|---|
| 01 | Attendance | 10 |
| 02 | Assignment(s) | 40 |
| 03 | Class Participation | 15 |
| 04 | Quiz | Nil |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam | Nil |
| 08 | Report-1 | 15 |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 20 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |

| | | |
|---|---|---|
| 14 | Lab Evaluation | Nil |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus:**

| Topics | Content |
|---|---|
| Identify your brand | Personal branding: meaning, importance and how to create and use it; the three Cs' of personal branding and personal branding through social media |
| Language for better branding | Importance of language in communication and how language can build brand. Avoiding common errors in verbal and written English language, and dos and don'ts of non-verbal language |
| Professional Story Mapping | Articulation practice on the various aspects of their professional persona – such as background, interests, achievements, education, internships, and so on. Use of story map to create professional journey and prepare for all kinds of FAQs |
| The Art of Networking | Meaning and benefits of networking and use of various networking styles. Offline and online networking – offline one-minute talk and ice-breaking conversations and online – professional messaging, invitation & emailing. |
| Resume | Resume types, structure of a resume, writing tips on resume – drafting, formatting and editing resume to create their final resume |
| Cover Letter | Purpose of a cover letter, types of cover letter, structure of a cover letter and tips on cover letter, to craft their cover letter to be used for placements |
| Elevator Pitch | Elevator Pitch: Meaning and use of an elevator pitch in interview and workplace; techniques to craft and improve their pitch |
| Group Discussion prep | Practice different types of group discussions, dos and don'ts of group discussions and use of techniques to perform well in GDs |
| Interview and FAQs prep | Practice FAQs and other behavioral questions, use of elevator pitch, refine GDs and PIs by using communication checklist - more practice of this in 7$^{th}$ semester |

**References:**

Reading Material will be provided by the facilitator to the students. Students can refer the following links.

**WEBLINKS:**

- https://www.fastcompany.com/28905/brand-called-you
- https://hbr.org/2015/03/how-to-separate-the-personal-and-professional-on-social-media
- https://brandyourself.com/definitive-guide-to-personal-branding
- http://pwgmarketing.com/2008/10/what-does-branding-mean-to-you/
- https://cra.org/cra-w/wp-content/uploads/sites/5/2015/05/Building-Your-Professional-Persona.pdf
- https://www.inc.com/marc-ecko/be-a-brand-not-a-label.html
- https://www.inc.com/marc-ecko/be-a-brand-not-a-label.html
- https://www.youtube.com/watch?v=rGbsb6aXbzc

| | |
|---|---|
| **Course Title and Code:** Intelligent Automation ID304, **(Open Elective-I)** | |
| Prerequisites | **Nil** |
| Hours per Week | **L-T-P: 2-0-0, Out Class-4 Weeks-12** |
| Credits | **2** |

**Course Description**

This course introduces an understanding of the fundamental concepts of Artificial Intelligence and Machine Learning, Internet of Things and Robotics. Focus of this course would be on discussion of case studies on various aspects.

**Learning Outcome**

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

1. Discussion sight fully role of artificial intelligence, IoT, robotics and data science in automation.
2. Propose & Evaluate use-cases involving Intelligent Automation
3. Analyze Case Studies pertaining to application of intelligence in Automation
4. Understand Role of IoT in Data Acquisition for Applying intelligence for automation
5. Appreciate Standards related to Intelligent Machines
6. Evaluate basic philosophical, ethical and Sustainability issues related to the development of Intelligent Machines

| Sr. No | Specifications | Marks |
|---|---|---|
| 01 | Attendance | 10 |
| 02 | Assignments (3) | Nil |
| 03 | Class Participation | 10 |
| 04 | Quiz (4) | 40 |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | Nil |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 (One Case Study Evaluated in three stages) | 40 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2(Final) | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus**

Case Studies on Various Domains including Smart City, Health Care, Customer Service, Sales and Marketing, Human Resource Management, Operations, Finance and Accounts, Auditing, Trading, Production, Manufacturing, Fake News Detection, Fraud Detection, Education, Law Case Analysis, Legal Proceedings, Automation of Patenting, Urban Analytics, Social Impact of AI.

| **Course Title and Code:** Advance Transport Phenomenon (CH1101) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | 4 |
| Students who can take | **B.Tech Semester-VII (Batch: 2016-2020) Core/Elective** |

**Course Objective:**

The course aims to provide an in-depth knowledge of heat, mass and momentum transport that is necessary in assessing, analyzing and developing typical chemical engineering and environmental technologies. The course focuses on modelling momentum, heat & mass transfer processes using analytical and numerical solutions of the partial differential equations of transport phenomena.

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

1. Assess the similarities between the transport processes and the effect of properties of the media on the overall process.
2. Apply the techniques for non-dimensionalized problems and construct the parameters that govern the evolution of transport phenomena.
3. Develop the model of transport phenomena and obtain analytical or computational solutions of the appropriate partial differential equations resulted in profiles of velocity, temperature, and concentration.
4. Develop and simulate model to analyze the combined effect of heat, mass and momentum transport in a typical chemical engineering equipment (heat exchanger, catalyst bed, chemical reactor, etc.)

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

**SYLLABUS:**

**Unit 1:** Scope and objectives of course, methodology, Newton's law of viscosity, molecular theories of viscosity, Convective momentum transport, Shell momentum balances, boundary conditions, Examples, Equations of continuity, motion, and mechanical energy, Examples

**Unit 2:** Dimensional analysis, Time-dependent flow of Newtonian fluids, Solving flow problems using stream functions and velocity potential, Boundary layer theory, Fourier's law of heat conduction, molecular theories of thermal conductivity, Convective transport of energy, work associated with molecular motions, Shell energy balances, examples, Forced and free convection, Various forms of energy equations, Examples

**Unit 3:** Unsteady state heat conduction in solids and in laminar flow, Boundary layer theory for non-isothermal flow, Fick's law of binary diffusion, molecular theories of diffusion, Mass and molar transport by convection, summary of mass and molar fluxes, Shell mass balance, boundary conditions, Examples, Equations of continuity, summary of multicomponent equations of change, Examples

**Unit 4:** Time-dependent diffusion, Steady state transport in binary boundary layers, Time-smoothed equations of change and velocity profiles, Empirical expressions for turbulent momentum flux; turbulent flow in ducts etc., Time-smoothed equations of change and temperature profiles for turbulent flow in tubes, Time-smoothed concentrations and equation of continuity and applications

## Textbook:

1. Bird, Stewart and Lightfoot, "Transport Phenomena"', John Wiley & Sons, 2nd ed., 2002.

## Reference Books:

1. Fox and McDonald, "Introduction to fluid dynamics", John Wiley & Sons, 5th ed., 2000.
2. Incropera F P "Principles of Heat and Mass Transfer", Wiley

| **Course Title and Code:** Process Engineering and Plant Design (CH1201) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | **4** |
| Students who can take | **B.Tech Semester-VI (Batch: 2016-2020)/ Elective** |

**Course Objective:**
The aim of this course is to focus on engineering and economic aspects involved in the development or modification of commercial process plants.

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

6) Apply various algorithms to synthesize a process flow sheet.
7) Calculate different costs involved in a process plant.
8) Design chemical process plant flow diagrams in view of economic & sustainability.
9) Calculate interest and time value of investments for process plants in view of economic, construction, safety, operability, and other design constraints
10) Evaluate the profitability of process industry projects using measures such as Return on Investment (ROI), Net Present Value (NPV) and Discounted Cash Flow Return (DCFR)
11) Perform breakeven analysis and optimum design of a process.

| **Prerequisites** | mass and energy balances, heat and mass transfer, fluid mechanics, and reaction engineering |
|---|---|

| **Sr. No.** | **Evaluation Component** | **Marks** |
|---|---|---|
| 1 | Attendance | 05 |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 05 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | 10 |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | 05 |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | 05 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**Course Syllabi (Theory):**

**Introduction: Basic concepts:** General design considerations, Process design development, Layout of plant items, Flow sheets and PI diagrams, Economic aspects and Optimum design, Practical considerations in design and engineering ethics, Degrees of freedom analysis in interconnected systems, Network analysis, PERT/CPM, Direct and Indirect costs, Optimum scheduling and crashing of activities.

**Flow-sheeting:** Synthesis of flow sheet: Propositional logic and semantic equations, Deduction theorem, Algorithmic flow sheet generation using P-graph theory, Sequencing of operating units, Feasibility and optimization of flow sheet using various algorithms viz, Solution Structure Generation (SSG), Maximal Structure Generation (MSG), Simplex, Branch-and-bound etc.

**Analysis of Cost estimation:** Factors affecting Investment and production costs, Estimation of capital investment and total product costs, Interest, Time value of money, Taxes and Fixed charges, Salvage value, Methods of calculating depreciation, Profitability, Alternative investments and replacements.

**Optimum Design and Design Strategy:** Break-even analysis, Optimum production rates in plant operation, Optimum batch cycle time applied to evaporator and filter press, Economic pipe diameter, Optimum insulation thickness, Optimum cooling water flow rate and optimum distillation reflux ratio.

## Syllabus (Practical)

9. Design & drawing of the urea manufacturing plant.
10. Design & drawing of the cement manufacturing plant
11. Design & drawing of the ammonia production plant
12. Design & drawing of the petroleum refinery
13. Design & drawing of the soap and detergent manufacturing plant
14. Design & drawing of the edible oil production plant
15. Design & drawing of the alcohol manufacturing plant
16. Design & drawing of the coal gas manufacturing plant

**Main References**

## Textbooks:

1. Peters, M.A. and Timmerhaus, K.D., Plant Design and Economics for Chemical Engineers, McGraw Hill (2003).
2. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill (1982).

**Reference Books:**


1. James M. Douglas, “Conceptual Design of Chemical Processes”, McGraw Hill, New York, International Edition, 1988.
2. Warren D. Seider, J. D. Seader, and Daniel R. Lewin, “Product & Process Design Principles: Synthesis, Analysis, and Evaluation”, John Wiley & Sons, New York, $2^{nd}$ Edition, 2004.
3. Robin Smith, “Chemical Process Design”, International Editions, McGraw Hill, Singapore, 2000.
4. Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, “Analysis, Synthesis, and Design of Chemical Processes”, International Edition, Prentice Hall, New Jersey, 1998.
5. Dale F. Rudd, and Charles C. Watson, “Strategy of Process Engineering”, John Wiley & Sons, New York, 1968.
6. Ulrich, G.D., A Guide to Chemical Engineering Process Design and Economics, John Wiley & Sons (1984).
7. Perry, R.H. and Green, D., Chemical Engineer's Handbook, McGraw-Hill (1997).

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| **CH1202 (Department Elective-III)** | **Advanced Separation Processes** | **3** | **0** | **2** | **4** |

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

**Syllabus (Theory):**

Adsorption-based separation, Concept of adsorber design, application of adsorption in different areas; cryogenic separation, Gas liquefaction, different air liquefaction cycles, Cryogenic distillation, refrigeration systems, techniques for storage and transportation; Membrane separation, Gas and liquid phase separation, pervaporation, liquid membrane, membrane reactor; biotechnology-based separation, Introduction to bio-kinetics, Types of bio-reactors and different techniques for bio-separation; Recent advancements on the above areas and new concepts such as simulated moving bed adsorption, thermally coupled pressure swing adsorption, reactive distillation, bio-filtration, supercritical fluid extraction

**Textbook:**

1. Seader, J. D. and E. J. Henley, "Separation Process Principles", John Wiley & Sons, Inc. (Wiley India (P) Ltd., New Delhi), 2nd Ed., 2006.

**Reference Books:**


1. Ruthven, D. M., S. Farooq and K. S. Knaebel, "Pressure Swing Adsorption", VCH Publishers, NY, 1994.
2. Barron, R., "Cryogenic Systems", Oxford University Press, NY, 2nd Ed. 1985.
3. Bailey, J. E. and D. V. Ollis, "Biochemical Engineering Fundamentals", Mc-Graw Hill, 1986.
4. Ruthven, D. M. "Principles of Adsorption and Adsorption Processes", John Wiley and Sons, 1984.
5. Mukhopadhyay M., "Natural Extracts using Supercritical Carbon Dioxide", CRC Press, LLC, Boca Raton, Florida, USA, 2000.
6. Research Papers from Refereed Journals / Resources.

| **Course Title and Code:** Industrial Safety Management (ME2101) | |
|---|---|
| Hours per Week | **L-T-P: 3-0-4** |
| Credits | **5** |
| Students who can take | **B. Tech Semester-VI CHE (Batch: 2016-2020) (Elective)** |

**Course Objective:**
The goal of this course is to develop understanding about Industrial safety programs and toxicology, Industrial laws, regulations and source models. The course also aims to impart knowledge of the industrial hazard, fire and explosion, preventive methods, relief, and sizing methods.

**After course completion, the student will be able to:**

8. Analyze the effect of the release of toxic substances.
9. Explain the industrial laws, regulations and source models.
10. Apply the methods of prevention of fire and explosions.
11. Identified the relief and its sizing methods.
12. Explain the methods of hazard identification and preventive measures.
13. Apply standard safety procedures in an industrial environment.

| | **Prerequisites** | Engineering Chemistry, Chemical Process Calculation, Mass Transfer, Heat Transfer |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | 05 |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 05 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | 10 |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | 05 |
| 9 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 05 |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| 16 | Course Portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory)**

**UNIT I: Techniques of safety management**

**Introduction:** Elements of safety Programming, safety management

**Upgrading development programs:** safety procedures, arrangements, and performance measures education, training and development in safety.

**UNIT II: Safety performing planning**

**Safety performance:** An overview of an accident, is it an accident, injury of the incident, the safety professional, occupational health and hygiene.

**Understanding the risks:** Emergency preparedness and response, prevention of accidents involving hazardous substances.

**UNIT III: Structured Exercise in safety management**

**Investigation and Prevention:** accidents of reasons, results, repair; the door of safety swings on the hinges of common sense.

**Safety systems**: the permit-to-work system, confined-space hazards

**Safeguarding against common potential hazards:** Trips, slips, and falls, prevention electrocution, static energy, hazard energy control

**Specific hazard control measures:** Forklift hazard control, Tractor hazard control

Safe handling and storage: materials handling, compressed gas cylinders, corrosive substances, hydrocarbons, waste drums, and containers.

**UNIT IV: Accidents Case Histories**

Bhopal gas tragedy, Gas-cutting a contaminated drum, tractor overturn, uncalled-for Enthusiasm, Lapse in safety organization, Lack of Procedural System and Supervision, Static Electricity, Failure of Anticipate Hazards, Malfunction and Failure of an ID Fan, Faulty Handling Equipment

**Unit V: Accidents Case Studies**

**Process and chemical handling**: an unexpected chemical reaction, expect the unexpected, lack of safety procedure, potential hazard not considered, Possibility of a toxic Gas leak not considered

**Machines and Equipment:** Faulty plant layout, Lack of Adequate Communication, a Makeshift Arrangement, Lack of work Organisation, Transfer of Technology Versus Suitability of Application, collapse of a Jib Crane, Fingers Trapped in Main-Loom-Drive, Wrong Position Button, Safe operating Procedure Not Followed.

**Fire:** Faulty Machine Connections, Chemical Vapours Catch fire, Manual Transfer of a Flammable Chemical, A Fire can Breakout Anywhere.

**Explosions:** Oxygen Cylinder-A potentials Explosion Hazard, Explosion of Condensate Receiver, An Air Compressor Explosion, Explosion in a Chemical Raw Material Store.

**Electricity:** Electrical Equipment Not Isolated, Connection without Plug.

**Other Categories:** Collapse of a factory Floor, an unplanned Operation, Fall during Erection of a Pipeline, Lack of Safe Operating Procedure.

**<u>Syllabus (Practical)</u>**

1. Identified Chemical hazard in the JKLU laboratories.
2. Identified Noise hazard in the JKLU campus.
3. Identified Biological hazard in the JKLU campus.
4. Identified Fire hazard in the JKLU laboratories.
5. Identified Physical hazard in the JKLU campus.
6. Identified Ergonomic hazard in the JKLU Campus.

**Main References**

## Textbooks

5. L.M. Deshmukh, "Industrial Safety Management" 15th edition, McGraw Hill Education (India) Pvt. Ltd. (2018).

## Reference books

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall, 2011.
2. Fawcett H.H. and W. S. Wood, Safety and accident prevention in Chemical operations 2nd edition John Wiley and Sons Inc. (1982).

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| CH1203 (Elective-IV) | Industrial Pollution Abatement | 3 | 0 | 4 | 5 |

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

**Syllabus (Theory):**

**UNIT I-Introduction:** Industrial pollution, Different types of wastes generated in an industry, Different water pollutants, Air pollutants and solid wastes from industry, Their effects on living and non-living things, Environmental regulatory legislations and standards, Importance of industrial pollution abatement, Concept of sustainable development, Greenhouse gases, Global warming and climate change.
**UNIT II-Water Pollution:** Identification, quantification and analysis of wastewater, Classification of different treatment methods into physico-chemical and biochemical techniques, Physico-chemical methods, General concept ofprimary treatment, Liquid-solid separation, Design of a settling tank, Neutralization and flocculation, Biological methods, Concept of aerobic digestion, Design of activated sludge process, Concept of anaerobic digestion, Biogas plant layout, Different UNIT operations and UNIT processes involved in conversion of highly polluted water to potable standards.
**UNIT III-Air Pollution:** Classification of air pollutants, Nature and characteristics of gaseous and particulate pollutants, Analysis of different air pollutants, Description of stack monitoring kit and high volume sampler, Atmospheric dispersion of air pollutants, Gaussian model for prediction of concentration of pollutant down wind direction, Concept of temperature inversion, Plume and its behavior, Concept of effective stack height, Operating principles and simple design calculations of particulate control devices like gravity settling chamber, cyclone, bag filters, electrostatic precipitators and scrubbers, Brief concepts of control of gaseous emissions by absorption, adsorption, chemical transformation and combustion.
**UNIT IV-Solid Wastes:** Analysis and quantification of hazardous and nonhazardous wastes, Treatment and disposal of solid wastes, Land filling, Leach ate Treatment, Incineration.
**UNIT V-Environmental Management System:** Environment impact assessment, Its concept and constituents, Environmental audit, ISO-14000 system.

**Syllabus (Practical)**

Characterization of wastewater (pH, BOD, COD, Nitrate, Phosphate, Solids, Turbidity, Alkalinity, Hardness, Dissolved oxygen and fluoride), Ambient air quality measurement by high volume sampler (Particulate, SOX, NOX), Gas analysis with Orsat apparatus, Determination of sludge volume index.

**<u>Textbooks:</u>**


1. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G. Environmental Engineering, McGraw Hill International (1985).
2. Metcalf & Eddy, Wastewater Engineering, Tata McGraw-Hill Education Private Limited (2009).


**<u>Reference Books:</u>**


1. Masters, G.M., Introduction to Environmental Engineering and Science, Prentice hall off India, (2008).
2. De Nevers, N., Air Pollution Control Engineering, McGraw-Hill (2000).
3. Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern (2010).


**<u>Web links</u>**

1. http://www.nptel.ac.in/courses/105102089/8
2. http://nptel.ac.in/courses/103107084/module1/lecture1/lecture1.pdf
3. http://www.openculture.com/free_certificate_courses
4. https://www.class-central.com/subject/civil-environmental-engineering
5. https://www.class-central.com/subject/environmental-science

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>SUR401</td><td>Survey Field Visit</td><td colspan="4">01 Week</td><td>2</td></tr>
</table>

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

Surveying Field Visit (Intensive Survey) (SUR401) – One Week -2 Credits

## Syllabus

Total station, functioning and measurements, **Field project using total station**, Global positioning system: definition, principles, Mapping of an area using global positioning system, transferring data into computer, **Field project using GPS.**

## Text and References Books:

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

**Course Title: A Critical Examination of Ethics & Development**
**Course Code: LS2101**
**Credit: 1**
**Trimester: III**

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**Course Description:**
The course engages with three interplaying sets of ideas falling under broad heads of law, ethics and development. The course will grapple with issues surrounding morality and justice and locate these ideas in relationship between the individual and the society, as manifested in moral aspirations of contemporary decision making. The course dissects *how* to find out what is the *right* thing to do, rather than *what* is the right thing, what are the limits of these findings, the role of law in ascertaining social choices and how must we construct these choices (particularly at leadership levels). In this context the course invokes deontology, utilitarianism, virtue ethics, environment, capabilities, developmental indicators and policy choices at applied level. By design, given the location of the course in a reimagined MBA program, the readings are biased in favour of accessibility rather than their canonical nature.

**Course Objective:**
The course is meant to ask questions, more than to offer answers. In doing so, it enables critical thinking to understand the way in which these questions must be asked, and manners in which an answer could be sought. In other words, the course cultivates a logical thinking and an appetite for meaningful argumentativeness. The course is not meant to replace a standard course in philosophy and ethics but poses important questions that disturb many of our mainstream assumptions, which lie buried in the cacophony of standardization obsession of our society. In addition to introducing philosophical concepts to students, navigating across politics, sociology, economics and law, it helps achieve a linear thinking in philosophy. The aim of the course is not only to bring complementary perspectives to important policy questions, it also nudges us to think about the idea of human flourishing.

**Course Outline:**
**Hour 1: Why ethics now – the Silicon Valley**
**Hour 2: Open Lecture – Revisiting Ethics of Reservation Policies**
**Hour 3: Patriotism and Loyalty (continued from open lecture)**
**Hour 4 and 5: Maximizing pleasure and minimizing pain (aggregate)**
**Hour 5 and 6: Categories of right and wrong**
**Hour 6 and 7: *Telos* – the central idea of purpose in our actions**
**Hour 8: Environmental Ethics**
**Hour 9 and 10: Ethics of development**

**Reading Materials:**
Michael Sandel (2012), Trubek and Santos (2012), Sen (2000), Nussbaum (2011), Ghertner (2008), Williams (1995), Goyal (2015, excerpts), Chamarro-Premuzic (2015), Sandel (1998), excerpts from pages in Stanford Encyclopedia.

| **Course Title and Code**<br>**CS1201: Robotic Process Automation** | |
|---|---|
| Hours per Week | **L-T-P: 2-0-4** |
| Credits | **4** |
| Students who can take | B.Tech.(CS/EC/EEE/CE/ME – V+VII, CHE-VII) Odd Sem |

**Course Objective:**

- The course aim is to develop understanding about Robotic Process Automation for automating business processes using software robots with cost efficient digital delivery.

**Learning Outcome:**

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

- Use and understand the various functionalities and features of UiPath Studio and Orchestrator.
- Design, implement, and use RPA activities.
- Develop basic robots using UiPath Community Edition.
- Explore various data extraction techniques.
- Deploy, monitor and control robots with UiPath Orchestrator.
- Identify processes which can be automated.
- Apply best practices in RPA projects.

**Prerequisites:** To understand and complete the course successfully the student must have basic programming skills.

| **Sr. No** | **Specifications** | **Marks** |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignments | 20 |
| 03 | Class Participation | 10 |
| 04 | Quiz | 10 |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | Nil |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project-1 | 20 |
| 12 | Project-2 | 20 |
| 13 | Project-3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2 | Nil |
| 16 | Course portfolio | 20 |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

Unit I: Programming Basic & Recap: Programming concept basic; **Introduction to RPA:** scopes and techniques of automation, RPA components and various RPA platforms, Introduction to UiPath as RPA platform, Applications and Benefits of RPA, Introduction to UiPath Studio, UiPath robot, types of robots, and UiPath Orchestrator. Brief on Studio interface and components.

Unit II: **RPA Projects:** Types of Projects in RPA: Sequence, Flowcharts, and State machines; Variables, Arguments, Data Types and Control flow: flow chart activities and sequences activities. **Data Manipulation:** Text and Data Manipulation**,** Data tables, clipboard management, file operation, importing from and exporting to CSV/Excel file and data table.

Unit III: **Control of Controls:** Attach window activity, Finding the control, Waiting for a control, Act on Control- mouse and keyboard activity. Handling event driven controls as working with UiExplorer handling events. Introduction to Recorder, OCR, types of OCR and Screen Scrapping Using OCR. **Selectors:** Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

Unit IV: **Application with Plugins and Extensions:** Java plugins, Citrix automation, Mail plugins, PDF plugins, Web integration, excel and word plugins. Extensions- Java, chrome, firefox, and Silverlight. **UiPath Advanced Automation concepts and techniques:** Image, Text and introduction of Citrix Automation; **Excel Data Tables & PDF:** Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors. **Email Automation:** Incoming Email automation, Sending Email automation.

Unit V: **Debugging and Exception Handling:** Common exceptions and ways to tackle them, Strategies for solving issues, Catching errors. **Introduction to Orchestrator:** Tenants, Authentication, Robots, Environments, Asset. **Capstone Project.**

**Syllabus (Practical):**

1. Setup, configuration, and introduction of components of UiPath Studio.
2. Execution of prebuilt examples of sequence, flow chart and state machines projects.

Create a sequence/Flow chart activity defining various types of variable as:

3. Generic Value Variables, Text Variables, Boolean Variables, Number Variables,
4. Array Variables, Date and Time Variables, Data Table Variables

Managing Arguments:

5. Create two activities, one activity defined with arguments and second activity which manages the argument to receive value from first activity.
6. Create an activity to manage importing active namespaces.

Create a project to Manage the control Flow:

7. The Assign Activity, The Delay Activity, The Do While Activity, The If Activity
8. The Switch Activity, The While Activity, The For-Each Activity, The Break Activity.

The Recording toolbar Activity:

9. Exercises using basic, web, and Desktop recoding.
10. Automate manual recording projects on Left-click on buttons, check boxes, drop-down lists, GUI elements, and Text typing

Data Scrapping:

11. Bot to extract structured data from your browser, application or document to a database, .csv file or even Excel spreadsheet.
12. Image and Text Automation
13. Excel Data Tables & PDF
14. Email Automation
15. Deployment of plugins and extensions.
16. Deploying and maintaining the BOT.

**Textbooks:**

T1 Tripathi, Alok Mani. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath. Packt Publishing Ltd, 2018.

T2. Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant." Middletown, DE. Omakustanne (2018).

**Reference Books:**

R1. Abhinav Sabharwal, “Introduction To RPA”, Independently Published Kindle Edition on Amazon Asia-Pacific Holdings Private Limited, 201 8

R2. Gerardus Blokdyk, “Rpa Robotic Process Automation”, 5Starcook, Second Edition, 2018

R3. Kelly Wibbenmeyer, “The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization” Paperback, iUniverse, 2018
R4. Willcocks, Leslie P., Mary Lacity, and Andrew Craig. "The IT function and robotic process automation." (2015).

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE542<br>Open Elective-II | Renewable Energy Systems | 3 | 0 | 2 | 4 |

**Syllabus:**

Overview of conventional energy sources, introduction to renewable energy resources, sector-wise energy consumption in India, historical review of renewable energy, solar irradiation on earth, solar thermal devices and storage, solar photovoltaic system and devices, wind energy technologies and geographical aspects, geothermal and biomass, basics of batteries and its types, performance comparison of batteries and usages, Fuel cell and its types, flywheels and super capacitors. Solar Photovoltaic Energy System (IEC TC82)

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| AS1201 | Operations Research | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:** This Course aims to develop various concepts and tools to help students understand the operations research and mathematical modeling methods.

**Learning Outcomes:**

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

1. Determining the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.
2. Formulate and translate a real-world problem, given in words, into a mathematical formulation.
3. Use these tools to analyze strategic, tactical and operational supply-chain decisions including facility location, vehicle routing and inventory management
4. Improve decision making by identify minimize trouble spots by identifying the critical factors.
5. Find reliability and operation analysis which includes system reliability analysis, failure investigation and corrective action.
6. Know how to work in a team, specifically to solve larger problems, communicate technical knowledge, partition a problem into smaller tasks, and complete tasks on time.

**Assessment Scheme:**

| **Prerequisites** | | **Operations Research** |
|---|---|---|
| **Teaching Scheme (Hours per Week)** | | L T P 3 0 2 |
| **Credits** | | 4 |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | Nil |
| 2 | Assignment | 10 |
| 3 | Class Participation | 5 |
| 4 | Quiz | 5 |
| 5 | Theory Exam-1 | 20 |
| 6 | Theory Exam-2 | Nil |
| 7 | Theory Exam-3 | 40 |
| 8 | Report-1 | Nil |
| 9 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Case Study – 1/ Project-1/Research Paper-1 | 20 |

| | | |
|---|---|---|
| 12 | Case Study - 2/ Project-2/Research Paper-2 | Nil |
| 13 | Case Study - 3/ Project-3/Research Paper-3 | Nil |
| 14 | Lab Evaluation-1 | Nil |
| 15 | Lab Evaluation-2 | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Course Syllabi (Theory):**

**Unit – I: Decision Analysis**

A Prototype Example, Decision Making without Experimentation, Decision Making with Experimentation, Decision Tress

**Unit – II: Markov Chain**

Introduction to Markov Chain, Stochastic Processes, Chapman-Kolmogorov Equations, Classification of States of Markov Chain

**Unit – III: Supply Chain Analysis and Inventory Management**

Introduction, Introduction to Supply Chain Management and Supply Chain Strategy, Supply Chain Performance Metrics and Drivers Objectives of Inventory Control, Types of Inventory

**Unit – IV: Network Optimization Models**

The Terminology of Networks, Shortest-Path Problem, Minimum Spanning Tree Problem, Project Management with CPM/PERT

**Unit – V: Reliability Theory**

Introduction, System Reliability, Failure Rates, Bathtub, Reliability of Systems, Practical Utility of Reliability Evaluation

**Course Syllabi (Practical):**

Problem solving using various software packages for the following areas.

1. Markov Chain
2. Supply Chain Analysis
3. CPM/PERT
4. Reliability Theory

**References:**


1. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., 2010 Ed. TMH.
2. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.
3. Srinivasan, G., OPERATIONS RESEARCH: PRINCIPLES AND APPLICATIONS, PHI Learning Pvt. Ltd, 2007.
4. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2017.

5. Ackoff, R.L. and Sasini, M. W., Fundamentals of Operations Research, Wiley & Sons, New York.
6. Waddington, C. H., O. R. in World War 2: Operational Research Against the U-boat, London, Elek Science, 1973.

**Course Title: Business and Sustainability**
**Course Code: LS2102**
**Credit: 1**
**Trimester: III**

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**Course Description:**
Sustainable development can be classified as development that meets the needs of the present without compromising the ability of future generations. The goal of sustainable development is to create and maintain prosperous social, economic, and ecological systems. These systems are intimately linked: humanity depends on services of ecosystems for its wealth and security.
Sustainable development is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depends. The desired result is a state of society where living conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system. It has been suggested that "the term 'sustainability' should be viewed as humanity's target goal of human-ecosystem equilibrium (homeostasis), while 'sustainable development' refers to the holistic approach and temporal processes that lead us to the end point of sustainability"
The Brundtland Report1 emphasized that sustainability is a three-legged stool of people, planet, and profit. Every one of us affects the sustainability of the marketplace and the planet in some way. The aim of this study module is to expand the understanding of business graduates on the touch-points they could have in the larger socio-economic context they will live and work in, and the ways in which their decisions and actions have a multiplier effect on decisions within their organisations, their communities, their countries and eventually the planet.

**Course Content:**
**Topic 1: Introduction to Sustainability**
1a) Introduction to the concept of sustainability and sustainable development
1b) Introduction to Sustainable Development Goals (SDGs): history, context, goals and targets, why they matter
Reading List:
1. UN 2012: The Future We Want. http://www.un.org/disabilities/documents/rio20_outcome_document_complete.pdf
2. UN 2015. Transforming Our World: The 2030 Agenda for Sustainable Development
3. http://www.un.org/en/development/desa/population/migration/generalassembly/docs/glo balcompact/A_RES_70_1_E.pdf 1 https://en.wikisource.org/wiki/Brundtland_Report
4. Our Common Future: The Brundtland Report Outcome 1987 https://en.wikipedia.org/wiki/Our_Common_Future

**Topic 2: The three pillars of sustainable development**
This session will delve deeper into the three main pillars of sustainable development include economic growth, environmental protection, and social equality, and their inter-relationships to achieve triple bottomline.
Reading List:
1. The three pillars of sustainable institutions https://www.investopedia.com/articles/investing/100515/three-pillars-corporatesustainability.asp
2. Human Development Report 2016. Technical Notes. http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf
3. The World Economic Situation-2018 https://www.un.org/development/desa/dpad/wpcontent/uploads/sites/45/publication/WESP2018_Full_Web-1.pdf
4. The Future of the Global Economy-OECD https://www.oecd.org/futures/35394025.pdf
5. Sustainability and Triple Bottomline https://www.researchgate.net/publication/322367106_SUSTAINABILITY_AND_TRIPLE_BOTTOM_LINE_AN_OVERVIEW_OF_TWO_INTERRELATED_CONCEPTS

**Topic 3: Sustainable Business Model Canvas**
This session will help scholars understand how to create a sustainable business model, based on which any organisational design and approach can be made sustainable for both new and existing businesses.
Reading List:
The Sustainable Business Model Canvas by Alexander Osterwalder https://medium.com/activatethe-future/designing-sustainable-business-models-and-product-service-systems-cd548328e852

**Note for Scholars:** • Session 1 will be followed by a class assignment and Introduction to group activity during Session 3

• The assignment will have a 20% weightage
• Assignment needs to be submitted at the beginning of Session 2
• All assignments will be individually submitted Session 2

**Topic 4: Measuring Sustainability**

Measurement of sustainability necessitates a key understanding of a few terms and processes, and this session will introduce scholars to the same, including

4a) Sustainability Reporting
4b) Sustainability Governance
4c) Sustainability Indicators

Reading List:

1. Global Energy Assessment 2014. Summary Findings, Chapter 19. http://www.iiasa.ac.at/web/home/research/Flagship-Projects/Global-EnergyAssessment/GEA_KF.pdf
2. Cities Can Save Us. TEDX talk by Aromar Revi https://www.youtube.com/watch?v=EkJyg0lc88A
3. Measuring Sustainable Development https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=801&menu=1 515

**Topic 5: Sustainability as a Business Driver**

This session will highlight through case studies ways in which businesses and institutions have benefitted by adopting a more sustainable agenda.

5a) Case Study 1- NHS
5b) Case Study 2- SAP
5c) Case Study 3- Patagonia

Reading List:

1. Case Studies on Market Transformation https://sustainabledevelopment.un.org/content/documents/full_rpt.pdf
2. Investment Needs to Achieve the Sustainable Development Goals (SDGs): Understanding the Billions and Trillions. http://unsdsn.org/resources/publications/sdg-investment-needs/
3. Sustainability for Consumer Businesses https://www2.deloitte.com/content/dam/Deloitte/dk/Documents/consumerbusiness/SustainabilityStoryGrowth-120712.pdf
4. Sustainability drivers for growth http://apki.net/wpcontent/uploads/2012/05/Collaboration-Innovation-Transformation.pdf

**Note for Scholars:**

• Specific Case studies that will be discussed in Topic 5 will be handed over to the scholars at the end of Topic 4
• Students will be expected to pre-read the case studies and be familiar with them
• The class discussion will have a 20% weightage
• Grading will be based on participation and quality of views/discussion points

**Activity and Group applying learnings from Sessions 1-2**

Note for Scholars:

• Scholars will be expected to come prepared for the activity. Those who have missed either of the two activities in topic 5 and topic 6 will need to update themselves to be able to participate in activity
•The outcome of the activity will be presented during this session by groups
• The activity and presentation will have a 60% weightage
• Grading will be based on participation (20%) and quality of presentation in terms of content (30%) and articulation (10%)

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| **AS1202** | **Advanced Statistics** | **3** | **0** | **2** | **0** | **4** |

**Course Objectives**: To familiarize students with the fundamentals of probability theory, random variables and random processes so that they can model different processes of communications, signal processing, computer science as stochastic processes and analyze them

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

1. Identify and formulate fundamental probability distributions and density functions.
2. Analyze continuous and discrete-time random variables and processes.
3. To model various real-life processes as stochastic process and analyze them.
4. Compute cumulative distribution function and normalizing constant for the probability density function of a random variable.
5. Apply the concept of algebra of random variables to analyze various linear systems.
6. Compute various important parameters of the resultant random variable to analyze the resultant behavior.
7. Design an experiment as a process and analyze it.

**Assessment Scheme:**

| | | |
|---|---|---|
| **Prerequisites** | | **Elementary Calculus** |
| **Teaching Scheme (Hours per Week)** | | L T P 3 0 2 |
| **Credits** | | 4 |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | Nil |
| 2 | Assignment | **10** |
| 3 | Class Participation | **5** |
| 4 | Quiz | **5** |
| 5 | Theory Exam-I | **20** |
| 6 | Theory Exam-II | Nil |
| 7 | Theory Exam-III | 40 |
| 8 | Report-I | Nil |
| 9 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 20 |
| 12 | Project-II | Nil |

| | | |
|---|---|---|
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | Nil |
| 15 | Lab Evaluation-II (Continuous) | Nil |
| 16 | Course Portfolio | Nil |
| | **Total (100)** | 100 |
| Evaluation Scheme for Re-Test | | |
| 1 | Theory Exam-III | 40 |
| | Total | 40 |

**Course Syllabi (Theory):**

**RANDOM VARIABLES**
Random variables, Distribution and density functions of random variables, Discrete and continuous random variables, Gaussian, Exponential, Rayleigh, Uniform, discrete Uniform and conditional distributions, distribution mean, variance, moments and characteristics functions.

**MULTIPLE RANDOM VARIABLES**
Function of two random variables, Distributions of two random variables, correlation coefficient, Joint moments, Joint characteristics functions, Conditional distributions, conditional expected values, statistical independence. Multiple random variables, distribution of sums of random variables, Central limit theorem.

**OPERATIONS ON MULTIPLE RANDOM VARIABLES**
Mean or expected value of multiple random variables, Variance, standard deviation, moments, Chebyshev's Inequality, moment generating function, characteristic function, covariance, variance of a linear combination of random variables, correlation.

**DESIGN OF EXPERIMENTS**
Analysis of variance, one-way classification, two-way classification, completely randomized design.

**STOCHASTIC PROCESSES**
Introduction, Stochastic Processes, Classification of a Random process, strict and wide sense Stationarity, cross correlation function, statistical averages, statistical independence, Ergodic random process, Mean Ergodic theorem, correlation functions, covariance functions, spectral representations, random processes and Linear Systems.

**Reference Books –**


1. J. Susan Milton and Jesse C. Arnold, 'Introduction to Probability and Statistics', McGraw Hill Education.
2. Papoulis, 'Probability, Random Variables and Stochastic Processes', TMH.
3. VK Rohatgi and AK Saleh, 'An Introduction to Probability and Statistics', Wiley

India.
4. Ross, ‘Stochastic Processes’, 2ed, Wiley.
5. H. Stark and J. Woods, ‘Probability and Random Processes with Applications to Signal Processing’, Third Edition, Pearson Education.
6. K. L. Chung, ‘Introduction to Probability Theory with Stochastic Processes’, Springer International Student Edition.
7. P. Kousalya, Probability, Statistics and Random Processes, Pearson.

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

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

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

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

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

**Course Syllabi (Theory):**

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

**Traffic Control & highway safety:** Traffic control devices, traffic signs and their classification, pavement markings, traffic island and their classifications, types and advantages of signals, coordinated signals, Miscellaneous traffic control aids-delineators, hazard markers, object markers, speed breakers, guard rails and barrier rails, road safety audits.

**Water and Waste Water Treatment:** Quantity Estimation, Water Sources, Water Supply/Distribution System, IS standards and tests for drinking water, treatment of Surface water, Waste water collection system, domestic waste water treatment, Introduction to microbiology, Biological unit processes, CNG production at Sewage treatment Plants, Sludge treatment, Use of manure for sustainable agriculture.

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

**Syllabus (Practical)**

1) Determination of PH of given in water /wastewater sample
2) Determination of Alkalinity in water sample.
3) To determine the Total Dissolved Solids of the given water/sewage sample
4) Determination of Hardness in water sample
5) Determination of turbidity of water supply system
6) Determination of chlorine demand and chloride residuals in water supply system
7) To determine Total Suspended Solids (TSS) of the given sewage sample.
8) To find out the Quantity of Dissolved Oxygen present in the given wastewater /water sample
9) Determination of Biochemical Oxygen Demand exerted by given wastewater sample.
10) To determine the elongation and flakiness index, Impact value, for an aggregate sample.
11) To determine the Crushing value and Abrasion value for an aggregate sample.
12) To determine the Softening point for a bitumen sample
13) To determine the Penetration value for a bitumen sample
14) To determine the Ductility for a bitumen sample

**Reference:**
**Books**

1) Kadiyali L. R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997.
2) Khanna, S. K. and C.E.G. Justo Highway Engineering Nem Chand and Bros, Roorkee, India, 2001.

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

**Video Lectures**

1) NPTEL >> Civil Engineering >> Water and Wastewater Engineering (Video)
2) https://nptel.ac.in/courses/120108005/
3) https://www.youtube.com

**Websites (related to the course)**

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

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="4">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Credits</th></tr>
<tr><td>EE541<br>Open Elective-II</td><td>Electrical Engineering Systems</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>

**Syllabus (Theory)**

Power Sector in India: Introduction to various institutions in Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, state and central governments, REC, utilities and their roles. Critical issues / challenges before the Indian power sector, Salient features of Electricity act 2003, Various national policies and guidelines under this act.
Features of Conventional and Renewable Generation: Introduction, Conventional Sources: Coal, Gas and Nuclear, Hydroelectric Power, Wind Power, PV and Solar Thermal Electricity, Tidal Power, Wave Power, Biomass, Power Generation Characteristics, Combining Sources.
Tariff and Power Sector Economic: Tariff: Power tariff, Government policies in force from time to time, Effect of renewable energy and captive power generation on tariff, Tariff for renewable energy.
Power Sector Economic: Cost components and cost structure, Investment options, Internal Rate of Return and Net Present Value of project, marginal costs, financing options, stakeholders. Role of regulation and evolution of regulatory commission in India.
Supply System: Structure of electric power system, Types of AC and DC distributors, distributed and concentrated loads, Distribution systems, feeder and distributor, radial, loop & grid system, primary feeder conductor size, Kelvin’s law. Computation of voltage drop, Transmission & distribution losses. IEC60439 standards.
Review of Principles of Power System Protection: General philosophy of protection, Relay terminology, Relay characteristics, Classification of Relays, characteristics and operating equation, Performance of conventional CT/PT as well as capacitive voltage transformers, Protection of motor, transformer and busbar, Relay co-ordination.

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

| **Sr. No** | **Specifications** | **Marks** |
|---|---|---|
| 01 | Attendance | NIL |
| 02 | Assignment | NIL |
| 03 | Class Participation | NIL |
| 04 | Quiz | NIL |
| 05 | Theory Exam (Mid Term) | NIL |
| 06 | Theory Exam | NIL |
| 07 | Theory Exam (Final) | NIL |
| 08 | Report-1 (Synopsis) | 10 |
| 09 | Report-2 | NIL |
| 10 | Report-3 | NIL |
| 11 | Project -1 (Mid Term) | 20 |
| 12 | Project -2 (Day to Day work)<br>(Demo, Presentation, Viva, Report) | 30 |
| 13 | Project -3 (End Term)<br>(Demo, Presentation, Viva, Report) | 40 |
| 14 | Lab Evaluation – I | NIL |
| 15 | Lab Evaluation – II | NIL |
| 16 | Course portfolio | NIL |
| | **Total (100)** | **100** |

**Course Syllabi:**

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

**Operation Procedure**

Student must devote full semester for Minor Project. Student must report to the Supervisor regularly. Seminars s evaluation has to be carried out in the presence of at least two-member Committee comprising. Experts in the relevant area constituted by the Supervisor.

Final Seminar Report to be submitted must be in formal hard bound cover bearing of the Institute emblem.

**Reference Books and Tools:**

Based on literature survey to be done with peer reviewed journals and magazines and relevant tools required to build the project.

## PR 1104 – Practice School II

### Course Syllabi:

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

| Course code | Course Title | Teaching Scheme | |
|---|---|---|---|
| | | Total Duration | Credits |
| **PS1102** | **PS-II** | 4 months | 16 |

**Evaluation Scheme:**

| Expert Evaluation | Evaluation Component | Mid-Term | Final Term |
|---|---|---|---|
| Industry Expert | Day to Day Task Record | 20 | 40 |
| | Report Content & Presentation | 10 | 30 |
| JKLU faculty | Reporting Activity Fortnightly | 08 | 18 |
| | Presentation, Viva, Report | 20 | 50 |
| | PS-2 Coordinator Feedback | 02 | 02 |
| | **Total** | **60** | **140** |

| Course code | Course Title | Teaching Scheme | |
|---|---|---|---|
| | | **Total Duration** | **Credits** |
| **PR2107** | **Industrial Project-II** | 4 months | 16 |

**Evaluation Scheme:**

| Expert Evaluation | Evaluation Component | Mid-Term | Final Term |
|---|---|---|---|
| Industry Expert | Day to Day Task Record | 20 | 40 |
| | Report Content & Presentation | 10 | 30 |
| JKLU faculty | Reporting Activity Fortnightly | 08 | 18 |
| | Presentation, Viva, Report | 20 | 50 |
| | PS-2 Coordinator Feedback | 02 | 02 |
| | **Total** | **60** | **140** |

| Course code | Course Title | Teaching Scheme | |
|---|---|---|---|
| | | **Total Duration** | **Credits** |
| **PR1105** | **Entrepreneurial Project** | 4 months | 16 |

**Evaluation Scheme:**

| Expert Evaluation | Evaluation Component | Mid-Term | Final Term |
|---|---|---|---|
| Industry Expert | Day to Day Task Record | 20 | 40 |
| | Report Content & Presentation | 10 | 30 |
| JKLU faculty | Reporting Activity Fortnightly | 08 | 18 |
| | Presentation, Viva, Report | 20 | 50 |
| | PS-2 Coordinator Feedback | 02 | 02 |
| | **Total** | **60** | **140** |

| Course code | Course Title | Teaching Scheme | |
|---|---|---|---|
| | | Total Duration | Credits |
| **PR1104** | **Research Project** | 4 months | 16 |

**Evaluation Scheme:**

| Expert Evaluation | Evaluation Component | Mid-Term | Final Term |
|---|---|---|---|
| External Expert | Day to Day Task Record | 20 | 40 |
| | Report Content & Presentation | 10 | 30 |
| JKLU faculty | Reporting Activity Fortnightly | 08 | 18 |
| | Presentation, Viva, Report | 20 | 50 |
| | PS-2 Coordinator Feedback | 02 | 02 |
| | **Total** | **60** | **140** |

**Syllabus of B.Tech. (CE) Batch 2016-20**

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE304 | Engineering Geology and Construction Material | 3 | 0 | 2 | 0 | 4 |

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

## Part 1: Engineering Geology

### Syllabus (Theory)

**Unit I: Earth Sciences:** Introduction,
**Basics of Engineering Geology:** Scope of Engineering Geology for a Civil Engineer
**Types of Geology:** Physical geology and mineralogy
**Unit II: Petrology:** Classification of rocks and their uses as building and road materials
**Failures in Earth crust:** Historical geology; Structural geology: Folds, faults, unconformity etc.
**Unit III: Investigation in Geology:** Engineering geology: Geological investigations at dam, tunnel and bridge sites and influence of various structures
**Precautions in different earth planes:** Precautions against faulting, folding, bedding planes, joints, cracks, fissures, permeability and ground water condition.

### Syllabus (Practical)

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

### Textbook(s)


1. Prof Parbin Singh, 'Engineering & General Geology" S K Kataria& Sons, 8 th edition, 2008
2. Principles of Engineering Geology, Bangar,

**Reference Book(s)**

1. Structural Geology by Billings
2. Petrology by Tyrll.

**Part 2: Building Construction and Materials**

**Course Syllabi (Theory):**

**UNIT IV:** Components of a building and their functions, foundation, shallow and deep foundation, grillage, raft, inverted arches, causes of failure of foundations and remedial measures, Masonry: types- Bricks and stone masonry, functions, material requirements, different bonds, damp proofing course

**UNIT V:** Shoring, under pining, scaffolding, horizontal and vertical shores, purpose and methods of under pinning, different types of scaffolding, floors and roofs: types, details of construction and materials

**UNIT VI:** Doors: paneled, glazed, flushed doors, collapsible steel doors, Windows: Casement, Sash, and Skylight windows, Staircase: Requirement of a good staircase, different types of staircases

**UNIT VII:** Physical and chemical characteristic of commonly used building materials in Civil Engineering construction – Clay, Sand, Stone, Lime, Cement, Concrete, Bricks, Silica, Aluminum and Timber with reference to its specifications. Plywood, asbestos, plastics and polymer-based materials.

**Textbook(s)**

1. B.C. Punmia, 'Building Construction' Laxmi Publications Pvt. Ltd Principles of Engineering Geology, Bangar,
2. Sushil Kumar, Building Construction, Standard Publishers, Delhi.

**Reference Book(s)**

1. Surendra Singh, Engineering Materials, Konark Publishers Pvt. Ltd.
2. D. S. Arora, 'Text Book of Engineering Materials', Kalyani Publishers

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE305 | STRUCTURAL ANALYSIS-I | 3 | 1 | 0 | 0 | 4 |

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

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

## Syllabus (Theory)

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

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

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

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

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

## Textbooks:

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

## Reference Books:

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE306 | FLUID MECHANICS | 3 | 1 | 2 | 0 | 5 |

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

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

## Syllabus (Theory)

**Unit-I: Introduction:** Fluid and continuum, Physical properties of fluids, Rheology of fluids. **Kinematics of Fluid flow:** Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, subcritical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body.

**Unit-II: Fluid Statics**: Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. **Dynamics of Fluid Flow:** Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its Application to pipe bends.

**Unit-III:** Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

**Unit-IV:** Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

**Unit-V:** Boundary Layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub layer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder.

**Syllabus (Practical)**

1. Determination of viscosity of oil
2. Establish relationship between pressure and height
3. Determination of metacentre of a floating body
4. Verification of conservation of energy in a duct based on Bernouli's theorem
5. Calibration of venturimeter, orificemeter, pitot tube and rotameter
6. Determination of coefficient of friction in close conduit as major losses
7. Determination of minor losses from bend, elbow, sudden contraction, enlargement
8. Lab exercises using Bentley WaterGEMS v8i.

**Reference Books:**


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

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

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

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

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

## Syllabus (Theory)

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

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

**Unit-3:** Modern surveying electronic equipment: digital levels, digital theodolites, EDMs, Total stations; Principles, working and applications; Lasers in surveying.

Total Station: Components Used in Total Station Surveying, functioning and measurements, Slope Staking , Topographic surveys, Construction project layout: building corners, control and offset lines, Leveling , Traverse surveys and adjustments ,Building Face Surveys, Resections, Road (Highway) Surveys.

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

## Syllabus (Practical)

1. Measurement of offsets for a building

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

**Text and References Books:**


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

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

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

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

## Syllabus (Theory)

**Unit 1:** Analysis of indeterminate beams & frames: Static determinacy and indeterminacy, strain energy and energy theorems – theorem of minimum potential energy, principle of virtual work, castigliano theorem, betti's law, clerk maxwell's reciprocal theorem, Force Method, displacement method, Three Moment Theorem, Column Analogy Method, moment distribution method.

**Unit 2; Analysis of trusses**: indeterminate truss by force method, displacement method

**Unit 3: Analysis of arches:** three hinged arches (determinate) and two hinged arches (indeterminate)

**Unit 4: Columns and Struts -** Definitions, Classifications, Assumptions made in the Euler's Column Theory, Expressions for crippling load of different cases like both the ends are hinged or pinned, one end is fixed and other is free, both ends are fixed, one end is fixed other is hinged, Effective length of column, Slenderness ratio, Crippling stress in terms of Effective length and radius of gyration, limitations of Euler's Formula, Rankine's Formula, Eccentric loading, Johnson's Formula for Columns, both straight line and parabolic formula for columns, Examples .

## Reference Books:


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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE407 | ENVIRONMENTAL ENGINEERING - I | 3 | 0 | 2 | 0 | 4 |

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

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

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

## Syllabus (Theory)

General requirement for water supply, Quality and quantity of water, Domestic water quality standards; Water analysis (ISO, WHO standards), Sources of water and their yield, Water supply forecast, population forecast, variation in demand pattern, design period; Intakes, pumping and transportation of water

Physical, chemical and biological characteristics of water and their significance, water quality criteria, appurtenances of water treatment and distribution systems, pump, pumping systems, pipes and fittings Designing a water treatment plant, process of treatment, mixing, aeration, sedimentation, coagulation, disinfection, softening, distribution systems- analysis and distribution of network, layout of distribution system, methods of water supply, distribution reservoir, capacity of reservoirs, introduction to water supply software, water CAD, EPANET2

## Syllabus (Practical)

1. Determination of turbidity, chlorine, pH, and hardness
2. Determination of turbidity using Aluminum Sulfate-Jar test.
3. Determination of chlorine demand and chloride residuals
4. Analysis of water quality, quantity parameters in a water supply system
5. Determination of various parameters in water treatment plant
6. Estimation of Nitrate nitrogen, Total Kjeldhal Nitrogen (TKN), and Ammonium Nitrogen in given water sample.
7. To find the optimum amount of coagulant required to treat the turbid water by Jar Test.
8. Designing a water distribution systems Software practice

## Textbook(s)

1. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
2. Environmental engineering: Water supply engineering, SK Garg, Khanna Publishers
3. Water supply Engineering, B.C. Punamia

**Reference Book(s)**

1. Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd
2. Wastewater Engineering, Metcalf and Eddy, McGraw-Hill Higher Education.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE408 | Building Planning and Drawing | 3 | 0 | 2 | 0 | 4 |

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

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

## Syllabus (Theory)

**Unit 1**: Definition and concept of plan of a simple residential building,
**Unit 2**: Elementary principles and basic requirements for building planning, elevation and section of a residential building.
**Unit 3**: Elementary principles and basic requirements for building planning, elevation and section of a Commercial Building.
**Unit 4:** Elementary principles and basic requirements for building planning, elevation and section of a Public Building.
**Unit 5:** Standard drawing discussion.
Manual Drafting and Digital Drafting of following Using AutoCAD: -

1. Symbols used in Civil Engineering drawing, Masonry Bonds
2. Doors, Windows and staircases.
3. Plumbing & Electrical fitting drawing.
4. Comprehensive Drawing of Residential building (Layout, plan, elevation & sectional elevation, plumbing & electrical fillings in out)
5. Preparation of Layout planning of different civil engineering Projects.
7. Preparation of lay out plan/Maps and building drawing using computer.

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

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

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

## Course Syllabi (Theory):

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

## Syllabus (Practical)

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

## Text Book(s)/ Reference Book(s)

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

<table>
<tr><th colspan="3" rowspan="2">Course code</th><th colspan="3" rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="3">CE507</td><td colspan="3">Design of RCC and Steel Structure</td><td>4</td><td>1</td><td>0</td><td>0</td><td>5</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test - II</th><th>End Term Test</th><th>Class Participation / Additional Continuous Evaluation*</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th>Class Participation / Additional Continuous Evaluation*</th><th>Total Marks**</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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

## Syllabus (Theory)

## Design of RCC structures

Methods of Design of Concrete Structures: Concept of Elastic method, ultimate load method and limit state method, Advantages of Limit State Method over other methods, Design codes and specification, Limit State philosophy as detailed in IS code, Design of flexural members and slabs by working stress method, Principles of Design of Liquid retaining structures, Properties of un-cracked section, Calculation of thickness and reinforcement for Liquid retaining structure

Limit State Design for Flexure: Analysis and design of one way and two-way rectangular slab subjected to uniformly distributed load for various boundary conditions and corner effects, Analysis and design of singly and doubly reinforced rectangular and flanged beams

Limit State Design for Bond, Anchorage Shear & Torsion: Behaviour of RC members in bond and Anchorage, Design requirements as per current code, Behaviour of RC beams in shear and torsion, Design of RC members for combined bending shear and torsion.

Limit State Design of Columns: Types of columns, Design of short column for axial, uniaxial and biaxial bending, Design of long columns.

RCC Slabs: Structural behaviour of slabs under UDL, Type of Boundary conditions, Design of one-way slab, Design of two-way slab with the help of tables of IS:456.

RCC Stairs: General principles for design of RCC stairs, Design of horizontally spanning stairs, Design of dog legged RCC stairs.

## Design of Steel Structures

**Introduction:** Properties of Structural Steel, Corrosion, Fire Protection, Indian Standard Specifications and Sections.

**Design Approach:** Design Requirements & Design Process, Analysis Procedures & Design Philosophy, Introduction to Limit State Design, Other Design Requirements.

**Connections:** Bearing Type Bolts, Friction Grip Bolts, Welded Connections, Hanger

Connections, Eccentrically Loaded Connections, Splice Connections.
**Compression Members:** Buckling Strength of Ideal Columns, Design of Axially Loaded Columns, Design of Angles Loaded through one-leg, Laced and Battenned Columns.

IS Codes:

1. Code of practice for plain and reinforced concrete IS: 456 (III revision) (with amendment I)
2. Code of practice for structural safety of Buildings IS: 875 Part I to V Loading standards. (revised)(with Amendment 1)

## **Textbooks:**

1. Shah and Karve; Limit State theory & Design of Reinforced Concrete
2. A. K. Jain; Design of Concrete Structures, Nemchand Publication
3. K. S. Sai Ram; Design of Steel Structures, Pearson
4. Arya & Ajmani; Design of Steel Structures
5. Dayaratnam; Design of Steel Structures

6 B. C. Punamia; Steel Structures, Laxmi Publication

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>CE508</td><td>Geotechnical Engineering</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
</table>

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<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
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</table>

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

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

**Syllabus (Theory)**

Fundamental definitions, origin and formation of soil. Phase Diagram, Voids ratio, Porosity, Percentage Air Voids, Air content, Degree of saturation, Water content, Specific Gravity of soil solids and soil mass, Densities and Unit weights - Bulk, Dry, Saturated & submerged and their inter relationships

Index Properties of soil- Water content, Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, in-situ density, Activity of Clay, Laboratory methods of determination of index properties of soils.
Permeability, Darcy's law- assumption and validity, coefficient of permeability and its determination, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, quicksand phenomena, Capillary Phenomena,
Concept of shear strength, Mohr-coulomb theory, conventional and modified failure envelops, Effective stress concept total stress, effective stress and Neutral stress, Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils
Compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control – compactive effort & method, lift thickness and number of passes, Proctor's needle, Compacting equipment
Consolidation: Definition, Terzaghi's one dimensional consolidation theory-assumption and limitations, Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination, Consolidation characteristics of soil

**Syllabus (Practical)**

1. Determination of moisture content
2. Determination of specific gravity
3. Field density test
4. Determination of Relative Density

5. Determination of sieve analysis
6. Determination of consistency limits and indices
7. Standard proctor compaction test
8. Permeability test
9. Unconfined Compression Test
10. Vane Shear Test

**Textbook(s)/Reference Books**


1. Soil Mechanics and Foundation Engg. Punmia B.C. (2005), $16^{th}$ Edition Laxmi Publications Co., New Delhi.
2. Principles of Soil Mechanics and Foundation Engineering- Murthy V.N.S. (1996), 4th Edition, UBS Publishers and Distributors, New Delhi.
3. Geotechnical Engineering; Braja, M. Das (2002), Fifth Edition, Thomson Business Information India (P) Ltd., India
4. Foundation Analysis and Design- Bowles J.E. (1996), 5th Edition, McGraw Hill Pub. Co. New York.
5. Soil Engineering in Theory and Practice- Alam Singh and Chowdhary G.R. (1994), CBS Publishers and Distributors Ltd., New Delhi.
6. Basic and Applied Soil Mechanics- Gopal Ranjan and Rao A.S.R. (2000), New Age International (P) Ltd., Newe Delhi.
7. Geotechnical Engineering- Donold P Coduto Phi Learning Private Limited, New Delhi
8. Geotechnical Engineering- Shashi K. Gulathi & Manoj Datta. (2009), Tata McGraw Hill.
9. Textbook of Geotechnical Engineering- Iqbal H. Khan (2005), 2nd Edition, PHI, India.
10. Numerical Problems, Examples and objective questions in Geotechnical Engineering- Narasimha Rao A. V. & Venkatrahmaiah C. (2000), Universities Press., Hyderabad.

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<tr><td rowspan="2">Course code</td><td rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>CE509</td><td>ENVIRONMENTAL ENGINEERING - II</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
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</table>

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

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

**Syllabus (Theory)**

Wastewater treatment, sewage and effluent, sources of wastewater, classification of wastewater, pollutions, characteristics and testing of sewage, composition, sampling, physical and chemical analysis
Industrial waste treatment: objectives, significance of treatment, classification of treatment processes, wastewater treatment, operations, screenings, skimming, sedimentation, biological treatment, aerobic and anaerobic treatment, trickling filters and design, LRTF & HRTF, types and modifications, activated sludge process, modes of wastewater disposal membranes
Sewage treatment, principles, ETP design, Energy recovery from waste, sludge digesters and biogas plants

**Syllabus (Practical)**

1. Determination of DO, COD and BOD
2. Analysis of water quality, quantity parameters in a wastewater
3. Designing a wastewater distribution system
4. Designing a filtration system.

**Textbook(s)**

1. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
2. Environmental engineering: Wastewater engineering, SK Garg, Khanna Publishers
3. Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd.

**Reference Book(s)**

1. Water and wastewater engineering, Metcalf and Eddy, McGraw Hill

| | | |
|---|---|---|
| **Course Title and Code**<br>**Hydrology and Water Resources Engineering**: CE 510 | | |
| **Course Description**<br>This course covers the one of major area of civil engineering, hydrology and water resources. In this course the water will be used as one of the sources for agriculture production and electricity production. Flood and drought management is also discussed in this course. | | |
| Prerequisites | | **Fluid Mechanics** |
| Hours per Week | | **L-T-P: 2-0-2 /**<br>**In Class - Out Class: 4-4** |
| Credits | | **3** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | 05 |
| 03 | Class Participation | 05 |
| 04 | Quiz | Nil |
| 05 | Theory Exam | 10 |
| 06 | Theory Exam | 10 |
| 07 | Theory Exam | 25 |
| 08 | Report-1 | 05 |
| 09 | Report-2 | 05 |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 15 |
| 12 | Project -2 | 20 |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation | Nil |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory)**

- Hydrological Cycle
- Rainfall: Measurements, occurrence, methods for estimation
- Runoff: Measurements, Estimation methods, Rainfall Runoff relationship
- Additional parameters of hydrological cycle
- Classification of rivers, river training and hydraulic structures (Bridge, Guide Bunds, etc.)
- Types of reservoir, site selection and zones in reservoir
- Flood and drought, Flood forecasting, flood routing, drought management
- Groundwater: Occurrence, estimation, contamination and its remedial measures

**Textbooks**

1. Punmia B.C., Irrigation and Waterpower Engineering, Standard Publishers.
2. Ragunath H.M., Hydrology, Willey Eastern Limited, New Delhi.
3. Subramanya K., Engineering Hydrology, Tata-McGraw Hill.

**Reference books**

1. Todd D.K., “Groundwater Hydrology", John Wiley & Sons, Inc, New York.
2. Bear J., "Hydraulics of Groundwater", McGraw-Hill, New York.
3. Modi P. N., “Irrigation, Water Resources and waterpower engineering-, Standard Book House.

| **Course Title and Code:** Transportation Engineering-I: CE511 | | |
|---|---|---|
| Hours per Week | | **L-T-P: 3-0-2** |
| Credits | | **4** |
| Students who can take | | **B.Tech. Semester VI (Civil engineering) / Core** |
| Prerequisites | | **N/A** |

**Course Objective:**

The aim of this course is to educate civil engineering students about highway design including flyovers and underpasses.

**Learning Outcomes:**

The students will be able to:

1. Gain knowledge regarding various specifications and standards set by organizations and official bodies.
2. Differentiate the working of various transport systems and their working in different scenarios.
3. Understand the factors influencing road vehicle performance characteristics and design.
4. Apply basic science principles in estimating stopping and passing sight distance requirement.
5. Understanding the functions of various components in Rail, Air, Water transport systems and their importance.
6. Design basic horizontal alignment and vertical alignment of the highways.
7. Design flexible and rigid pavements as per IRC.
8. Use EXCEL tools for design of vertical and horizontal curves.

| **Sr. No** | **Specifications** | **Weightage** |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignment | 10 |
| 03 | Class Participation | 5 |
| 04 | Quiz | 5 |
| 05 | Theory Exam | 10 |
| 06 | Theory Exam | 10 |
| 07 | Theory Exam | 25 |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 10 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation | 10 |
| 15 | Lab Evaluation | 15 |

| | | |
|---|---|---|
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Course Syllabus ( Theory):**

**PRINCIPLES OF TRANSPORTATION ENGINEERING**: Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport, Road types and classification, road patterns, planning surveys, Indian Roads Congress Guidelines

**HIGHWAY GEOMETRIC DESIGN:** Ideal Alignment, Factors affecting the alignment, Terrain classification, Design speed, Factors affecting geometric design, Cross sectional elements-Camber- width of pavement- Shoulders-, Width of formation- Right of way, Typical cross sections; Sight Distance-Restrictions to sight distance- Stopping sight distance- Overtaking sight distance- overtaking zones- Examples on SSD and OSD- Sight distance at intersections, Horizontal alignment-Radius of Curve- Super elevation – Extra widening- Transition curve and its length, setback distance – Examples, Vertical alignment-Gradient-summit and valley curves

**PAVEMENT MATERIALS**: Sub grade soil – desirable properties-HRB soil classification-determination of CBR and modulus of sub grade reaction-Examples, Aggregates-Desirable properties and list of tests, Explanation on Tar, bitumen, cutback and emulsion-List of tests on bituminous materials; PAVEMENT DESIGN: Pavement types, component parts of flexible and rigid pavements and their functions, design factors, ESWL and its determination, Flexible pavement- Design of flexible pavements as per IRC;37-2001-, Rigid pavement- Westergaard's equations for load and temperature stresses- Design of slab thickness only as per IRC:58-2002

**PAVEMENT CONSTRUCTION**: Earthwork –cutting-Filling, Preparation of sub grade, Specification and construction of i) Granular Sub base, ii) WBM Base, iii) WMM base, iv) Bituminous Macadam, v) Dense Bituminous Macadam vi) Bituminous Concrete, vii) Dry Lean Concrete sub base and PQC viii) concrete roads; HIGHWAY DRAINAGE: Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, design of filter materials; HIGHWAY ECONOMICS: Highway user benefits, VOC using charts only-Examples, Economic analysis – annual cost method-Benefit Cost Ratio method-NPV-IRR methods- Examples, Highway financing-BOT-BOOT concepts.

**Syllabus (Practical)**

1. To determine the elongation and flakiness index, Crushing value, Impact value, Abrasion value for an aggregate sample.
2. To determine the Softening point. Penetration value, Ductility value for a bitumen sample.
3. Design a bitumen mix using Marshall Method.

**Reference:**

1. Kadiyali L. R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997.
2. Khanna, S. K. and C.E.G. Justo Highway Engineering Nem Chand and Bros, Roorkee, India, 2001.
3. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fourth Edition, Indian Roads Congress, New Delhi, India, 2001.
4. IRC Codes of Practices
5. Papacostas C. S. and P D Prevedouros Transportation Engineering and Planning, Third Edition. Prentice Hall of India Pvt. Ltd, New Delhi, India, 2002.

| | |
|---|---|
| **Course Title and Code:** Geotechnical Engineering-II: CE608 | |
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | **4** |
| Students who can take | **B. Tech Semester-VI (Civil Engineering) / Core** |

**Course Objective:**

The aim of this course is to educate civil engineering students about foundation design.

**Learning Outcomes:**

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

1. Be able to comprehend and utilize the geotechnical literature to establish the framework for foundation design.
2. Derive solutions for problems of bearing capacity of soils.
3. Design a shallow foundation for a structure.
4. Evaluate the importance of raft foundation and principles of design for buildings and tower structures.
5. Be able to plan and implement a site investigation program including subsurface exploration to evaluate soil/structure behavior and to obtain the necessary design parameters.
6. Be able to carry out laboratory and field compaction tests for preparation of foundation surfaces and placement of engineered fill.
7. Be able to determine allowable bearing pressures and load carrying capabilities of different foundation systems.

| Prerequisites | | Geotechnical -I |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | NIL |
| 02 | Assignment | 10 |
| 03 | Class Participation | 5 |
| 04 | Quiz | 5 |
| 05 | Theory Exam | 10 |
| 06 | Theory Exam | 10 |
| 07 | Theory Exam | 25 |
| 08 | Report-1 | NIL |
| 09 | Report-2 | NIL |
| 10 | Report-3 | NIL |
| 11 | Project -1 | 10 |
| 12 | Project -2 | NIL |
| 13 | Project -3 | NIL |
| 14 | Lab Evaluation-1 | 10 |
| 15 | Lab Evaluation-2 | 15 |
| 16 | Course portfolio | NIL |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

**Unit1: STRESSES IN SOILS:** Boussinesq's and Westergaard's theories for concentrated, circular and rectangular loads. Comparison of Boussinesq's and westergaard's analysis. Pressure distribution diagrams, Contact pressure, Newmark's chart.

**Unit2: FLOWNETS:** Laplace equation (no derivation) assumptions and limitations only, characteristics and uses of Flownets, Methods of drawing flownets for Dams and sheet piles. Estimating quantity of seepage and Exit gradient. Determination of phreatic line in earth dams with and without filter. Piping and protective filter.

**Unit3: STABILITY OF EARTH SLOPES:** Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of infinite slopes, Stability of finite slopes by Method of slices and Friction Circle method, Taylor's stability number, Fellineous method. Slope stability analysis, flexible and rigid retaining wall, gravity, cantilever, counter fort, reinforced earth, etc., design and check for stability.

**LATERAL EARTH PRESSURE:** Active and Passive earth pressures, Earth pressure at rest. Rankine'sand Coulomb's Earth pressure theories-–assumptions and limitations, Graphical solutions for active earth pressure (cohesion less soil only) – Culmann's and Rebhann's methods, Lateral earth pressure in cohesive and cohesionless soils, Earth pressure distribution. Earth pressure theories, effect of water table, layered soils.

**Unit4: BEARING CAPACITY:** Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's and Brinch Hansen's bearing capacity equations - assumptions and limitations, bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Field methods of evaluation of bearing capacity - Plate load test, Standard penetration test and cone penetration test.

**Unit5: Subsurface Exploration:**

Importance of exploration program, Methods of exploration: Boring, Seismic refraction method of geophysical exploration, Types of samples - undisturbed, disturbed and representative samples, Samplers, sample disturbance, area ratio, Recovery ratio, clearance, Stabilization of boreholes - Typical bore log. Number and depth of borings for various civil engineering structures, soil exploration report, Advanced Instrumentation.

**Syllabus (Practical)**

1. Porosity determination by Funnel and Core Cutter method, validation with formula-based method,
2. Grain Size Distribution of Fine-Grained soil using Hydrometer method
3. Consolidation Test
4. Direct Shear Test
5. Triaxial Shear Test
6. Standard Penetration Test
7. Determination of Free Swell Index and Swelling Pressure

8. California Bearing Ratio Test
9. Case study for sensor Designing

**Textbooks:**


1. Gopal Ranjan and Rao A.S.R. (2000), Basic and Applied Soil Mechanics New Age International (P) Ltd., New Delhi.
2. Alam Singh and Chowdhary G.R. (1994), Soil Engineering in Theory and Practice, CBS Publishers and Distributors Ltd., New Delhi.
3. Punmia B.C. (2005), soil Mechanics and Foundation Engg. 16th Edition Laxmi Publications Co. New Delhi.
4. Murthy, V.N.S.,"Soil Mechanics and Foundation Engineering", 4thEdition ,Sai Krupa Technical Consultants, 2000.

| Course Title and Code<br>**Estimating Costing and Evaluation Engineering**: CE609 | |
|---|---|
| Hours per Week | **L-T-P: 3-1-0** |
| Credits | **4** |
| Students who can take | **B. Tech Semester-VI (Batch: 2016-20 and Batch 2017-2021)/ Core** |

**Course Objective:**

The goal of this course is to facilitate understanding about estimation, costing, tendering and evaluation of various type of civil engineering projects. This course will also facilitate the students to carry out cost-benefit studies of different types of civil engineering projects.

**Learning Outcomes:**

**After course completion, the student will be able to:**

1. Compare various type of estimates i.e. plinth area rate, cubical concentrate rate, original and supplementary, for different type of civil engineering projects.
2. Prepare measurements and abstract sheets for different type of civil engineering projects.
3. Determine various factors involved in the rate analyses for different types of items used in construction
4. Prepare detailed estimates of various civil engineering projects i.e. buildings, roads, canal and water supply schemes using the Basic schedule of rates for different Circle areas.
5. Analyze and evaluate various factors on which the cost of work depends in civil engineering projects in different circle areas.
6. Calculate various type of charges in a project.
7. Consider environmental factors in project planning.
8. Evaluate real estate properties by price per square foot, price per unit, gross multiplier, capitalization rate and cash on cash.
9. Prepare estimate using the Microsoft Excel and Estimator 2.0 for Civil Engineering construction projects.

| **Prerequisites** | Building Design, Building Material, Concrete Technology, RCC and Highway Engineering | |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | NIL |
| 2 | Assignment | NIL |
| 3 | Class Participation | 5 |
| 4 | Quiz | NIL |
| 5 | Theory Exam-I | 15 |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 35 |
| 8 | Report-I | 10 |

| | | |
|---|---|---|
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | 10 |
| 12 | Project-II | 10 |
| 13 | Project-III | 15 |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

**Introduction:** Purpose and importance of estimates, principles of estimating. Methods of taking out quantities of items of work. Mode of measurement, measurement sheet and abstract sheet; bill of quantities. Types of estimate, plinth area rate, cubical content rate, preliminary, original, revised and supplementary estimates for different projects.
**Rate Analysis:** Task for average artisan, various factors involved in the rate of an item, material and labor requirement for various trades; preparation for rates of important items of work. Current schedule of rates. (C.S.R.)
**Estimates:** Preparing detailed estimates of various types of buildings, R.C.C. works, earth work calculations for roads and estimating of culverts, Services for building such as water supply, drainage and electrification.
**Cost of Works:** Factors affecting cost of work, overhead charges, Contingencies and work charge establishment, various percentages for different services in building.
**Valuation:** Purposes, depreciation, sinking fund, scrap value, year's purchase, gross and net income, dual rate interest, methods of valuation, rent fixation of buildings.
**(Self-Reading Component) Contract and Tendering process along with Litigation.**

**Text Books:**

1. Dutta, B. N., "Estimation and Costing", UBS Publishers, 2002.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE1110 | Construction Project Management | 3 | 0 | 2 | 0 | 4 |

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

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

## Syllabus (Theory)

**FINANCIAL EVALUATION OF PROJECTS AND PROJECT PLANNING:** Capital Investment proposals, criterions to judge the worthwhileness of capital projects Categories of construction projects, objectives, Functions of project Management, Project management organization and staffing

**PROJECT SCHEDULING:** Importance of project scheduling, project work breakdown process determining activities involved, assessing activity duration, duration Estimate procedure, Project work scheduling, Project management techniques – CPM and PERT networks analysis, concept of precedence network analysis.

**PROJECT COST AND TIME CONTROL:** Monitoring the time progress and cost controlling measures in a construction project, Process of crashing of activities, determination of the optimum duration of a project, Updating of project networks, resources allocation.

**SUSTAINABLE CONSTRUCTION MANAGEMENT (Three Steps):** Use alternatives for sustainable construction materials, implement just in time production for more sustainable construction projects, integrated alternative sustainable construction methods

**SAFETY AND OTHER ASPECTS OF CONSTRUCTION MANAGEMENT:** Causes and prevention of accidents at construction sites, Safety measures to be followed in various construction works Project Management Information System – Concept, framework, benefits of computerized information system. Environmental and social aspects of various types of construction projects. IS guidelines for Project Management

## Syllabus (Practical)

Uses of PRIMVEERA and MS PROJECT.

## References:


1. Iyer P. Parameshwar (2001) Engineering Project Management with case studies. Wheeler Publishing New Delhi.
2. Nicholas John M (2007) Project Management for Business and Technology: Principles and Practice, 2nd Edition, Pearson Prentice Hall New Delhi

3. Austen AD & Neele RH (1985) Managing Construction Projects: A guide to process and procedures, Dialogue New Delhi
4. Joy PK (1990) Handbook of Construction Management, Macmillan Delhi
5. PERT and CPM by B.C. Punmia

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

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

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

## Course Syllabi (Theory):

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

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

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

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

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

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

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

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

**Free Vibration Analysis of MDOF systems – I:** MDOF systems, selection of DOFs, formulation of equations of motion, Stiffness matrices, Static condensation, Free Vibration as

Eigen Value problem, Frequencies and Mode Shapes, Determination of natural frequencies and mode shapes by Stodola- Vianello method, Orthogonality conditions.

.

**Text Books:**


1. Dynamics of Structures –A.K. Chopra
2. Structural Dynamics - Mario Paz CBS Publication
3. Earthquake Resistant Structures –D.J. Dowrick John Wiely Publication
4. Dynamics of Structures – R. M. Clough and Penzian , McGraw Hill co. New Delhi
5. Mechanical Vibrations – G. R. Grover Roorkee University, Roorkee
6. Analysis and Design of Foundations for Vibrations – P. J. Moove. Oxford and I. B. H. Publication, Delhi


**Reference Books:**


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

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **Credits** |
| **CE 722** | **EIA and Environmental Auditing** | 3 | 0 | 2 | 4 |

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

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

## Syllabus (Theory):

**Introduction:** Environmental Assessment process, Need of EIA, Environmental Auditing for sustainable development, objectives of EIA, Terminology, and Hierarchy in EIA, Historical Review of EIA, and Concepts related to EIA, Basic data collection for EIA.

**Legislation, Procedures and Standards:** National Environmental Policy Act and Implementation, EIA legislative requirements and administrative procedures in India/Indian States, EIA notification 2006.

**Techniques and Methodology:** Description of the environmental setting, baseline data collection for EIA, Methods of Impact Analysis, Prediction and Assessment of Impacts, Environmental risk assessment, Public Participation, Preparation & writing of EIA report.

**Case studies of EIA** for Industries like Oil, Petrochemical, iron and steel, fertilizer, sugar and distillery, projects of road/dams and housing etc.

**Environment Management Plan**: Planning, selection of appropriate procedures, Introduction to Environmental budget, to minimize environmental Impacts.

**Environmental Audit:** Definition of Environment Audit and its importance for industries. Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance. Concept of 1SO14000.

## Textbook(s)/ Reference Book(s)


1. Larry W. Canter," Environment Impact Assessment", McGraw-Hill Book Company, New York.
2. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Handbook, McGraw Hill, 1980.
3. Vijay Kulkarni and T V Ramchandra. “Environmental management” Capital Publishing Co.
4. Mhaskar A.K., “Environmental Audit" Enviro Media Publications.
5. S.K. Dhameja, "Environmental Engineering and Management" S.K. Kalaria and Sons Publishers.

| Course code | Course Title | Teaching Scheme | | | | Credits |
|---|---|---|---|---|---|---|
| | | L | T | P | S | |
| CE1203 | Irrigation Engineering | 3 | 0 | 2 | 0 | 4 |

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

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

## Course Syllabi (Theory):

Necessity of Irrigation in India, Advantages and disadvantages, techniques of irrigation water, Quality of irrigation water, Crop water requirements, crops and crop season, Consumptive use, Irrigation requirements, Estimation of consumptive use of water by climatic approaches, Irrigation efficiencies, Soil moisture-irrigation relationship

Canal Irrigation: Classification of canals, Canal losses, alignment of canals, Design of Irrigation Canals with IS Codes: Design of stable channels using Kennedy's and Lacey's theory, Garret's diagram, Cross section of irrigation canals, Lining of Irrigation Canals: Advantages and economics of lining, Various types of lining, Design of lined canals

Types of Cross-Drainage Works: Types of CD works, Design consideration for CD works with IS Codes, Canal Falls: Necessity, Proper location, Types, Design and detailing of one type of fall (IS codes); Weirs and Barrages: Weirs and Barrages, Types of weirs and barrages, Layout of a diversion head work, Introduction of different components of a diversion head works, Design of weirs and barrages: Bligh's creep theory, Design of weir using Bligh's theory, Lane's weighted creep theory, Khosla's theory, Khosla's method of independent variables, Exit gradient

Dams: Typical cross section, Various forces acting on gravity dam, Combination of forces for design, modes of failure and criteria for structural stability, High and low gravity dam, Design of high dam, Spillways: Descriptive study of various types of spillways

Sustainable Irrigation Practices: Drip Irrigation, Sprinkler Irrigation, Reclamation of Water Logged and Saline Soils, Reclamation of saline and alkaline land, Surface and Sub-surface drainage

**Textbook(s)/ Reference Book(s)**


1. Irrigation engineering and hydraulic structures, SK Garg, Khanna Publishers
2. Irrigation and waterpower engineering, BC Punamia, Pandey BB Lal, Standard Publishers
3. Principles and practice of irrigation engineering, SK Sharma, S Chand and Company.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CE732 | GROUND IMPROVEMENT TECHNIQUES | 3 | 0 | 2 | 0 | 4 |

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

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

## Syllabus (Theory)

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

## Textbooks:

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

**Reference Books**

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

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2" colspan="5">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>CE1204</td><td colspan="5">Advanced Transportation Engineering</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><th colspan="6">Evaluation Scheme (Theory)</th><th colspan="5">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test - II</th><th>End Term Test</th><th>Class Participation</th><th>Additional Continuous Evaluation*</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th>Class Participation</th><th>Additional Continuous Evaluation*</th><th>Total Marks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

## Syllabus (Theory)

Traffic Surveys: Objects, methods and data presentation of various traffic surveys such as classified traffic volume studies; spot speed studies; travel time and delay studies; origin & destination studies. Parking studies: Investigations and determination of parking demand; Accident studies: Objectives & causes of accidents; various steps involved in accident studies; 3Es measures used for the reduction of accident rate.
Statistical Methods for Traffic Engineering: Elementary concepts of probability, mean, standard deviation and variance, Binomial, Poisson & Normal distribution, sampling theory and significance testing, Linear Regression and correlation.
Traffic Control Devices: Traffic signs-classifications & general specifications, Signals-advantages and warrants of traffic signals; design of signals, Road markings: objects & classification. Road Intersections: Classifications and importance; design of rotary intersection.
Bitumen grading system: Penetration grading, viscosity grading and superpave performance grading, Modified bitumen binders such as PMB & CRMB.
Hot Mix Asphalt Mix Design: Various methods of mix design, objectives of mix design, gradation and blending of aggregates, volumetric properties of compacted specimens, analysis of compacted asphalt mix, Marshall mix design procedure.
Types of bituminous mixes based on gradation: Dense graded; semi-dense graded; open graded and gap graded. Different types of bituminous mixes used in India,
Recycled Asphalt Pavements (RAP): Benefits and methods of recycling, Hot recycling materials and mix design, Materials and mix design for cold mix asphalt recycling.

## Textbooks:

1. Traffic Engineering & Transport Planning by L R Kadiyali, Khanna Publishers, New Delhi.
2. Bituminous Road Construction in India by Prithvi Singh Kandhal, PHI Learning Pvt. Ltd.
3. Highway Engineering by S K Khanna, CEG Justo & Veeraragavan, Nem Chand Bros, Roorkee
4. Transportation Engineering by C. Jotin Khisty & B. Kent Lall, Pearson.

**Codes:**

1. IRC: 9 -1972: Trattic Census on Non-Urban Road, IRC, New Delhi.
2. IRC: 2 -1968: Route Marker Signs for National Highways, IRC, New Delhi.
3. IRC: 30 -1968: Standard Letters and Numerals on Different Heights for use as Highway Signs, IRC, New Delhi.
4. IRC: 35 -1970: Code of Practice for Road Markings (with Paints), IRC, New Delhi.
5. Specifications for Road and Bridge Works, Ministry of Surface Transport & Highways, IRC, New Delhi.
6. IRC: 73 -2013: Paving Bitumen – Specifications, Bureau of Indians Standards.
7. IS -15462 -2004: Polymer and Rubber Modified Bitumen–Specifications, Bureau of Indian Standards

| **Course Title and Code**<br>Mobile Application Development: CS1205 | |
|---|---|
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | **4** |
| Students who can take | B.Tech Sem VI |

**Course Objectives:** This Course is designed to offer learners an introduction to Android platform and related applications in the business world. Learners would be introduced to different cross platforms like IONIC, REACT NATIVE, and TABRIS.JS. The Course will cover ethical contents and security related issues in app deployment at Google Play Store. All techniques will be illustrated using different app design with real-time and static databases.

**Learning Outcome:**

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

1. develop high-level plans for script solutions for mobile and evaluate the post-production outcome;
2. design scripts to meet given interface and media control requirements;
3. use variables, properties and other code elements appropriately to implement the code design;
4. devise, carry out and evaluate functional test strategies of mobile design;
5. implement and evaluate techniques for the installation of mobile applications and delivery via various channels;
6. explain the principles of technologies which support media production and delivery on a variety of platforms;
7. create event listeners and responding to events;
8. give permissions and Android manifests;
9. tying Android XML resources to Java code;
10. create a Google Play Store account and preparing apps for the Play Store.

| Prerequisites | | **Basics of Computer Networks** | |
|---|---|---|---|
| **Sr. No** | **Specifications** | **Marks** (Pre-Covid) | **Post-Covid** |
| 1 | Attendance | Nil | Nil |
| 2 | Assignment | Nil | 30 |
| 3 | Class Participation | Nil | 10 |
| 4 | Quiz | Nil | Nil |
| 5 | Theory Exam-I | Nil | Nil |
| 6 | Theory Exam-II | **20** | Nil |

| | | | |
|---|---|---|---|
| 7 | Theory Exam-III | **30** | 20 |
| 8 | Report-I | Nil | Nil |
| 9 | Report-II | Nil | Nil |
| 10 | Report-III | Nil | Nil |
| 11 | Project-I | **30** | 40 |
| 12 | Project-II | Nil | Nil |
| 13 | Project-III | Nil | Nil |
| 14 | Lab Evaluation-I | **10** | Nil |
| 15 | Lab Evaluation-II | **10** | Nil |
| 16 | Course Portfolio | Nil | Nil |
| | **Total (100)** | **100** | **100** |
| | | | |
| **Re-Test Evaluation** | | | |
| | **Theory Exam-III** | **30** | **30** |
| | **Total:** | **30** | **30** |

**Syllabus (Theory)**

**Module I – Mobile Application Overview**

Introduction to Mobile Computing, Introduction to Android Development Environment, Mobile Software Engineering, Design of application (view level).

**Module II – Framework and User Interface Development**

Frameworks and Tools, Generic UI Development, Android User (privileges), VUIs and Mobile Apps Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodial UIs, Android Intents and Services, Characteristics of Mobile Applications
Successful Mobile Development.

**Module III – Storing Retrieving Data with Real-time Database**

Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider, Communications Via Network and the Web, State Machine, Correct Communications Model, Android Networking and Web.

**Module IV – Notifications, Alarming and Location**

Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia, Mobility and Location Based Services.

**Textbooks and References:**


- Android Cookbook, 2nd Edition by Ian F. Darwin Publisher: O'Reilly Media, Inc. Release 2017
- Sam’s Teach yourself Android Application Development. By Lauren Darcey and Shane Conder: 2012
- Professional Android 4 Application Development by Reto Meier, 2012
- Android Programming for Beginners by John Horton, 31 Dec 2015
- https://developer.android.com/

**WEBLINKS:**

- https://www.fastcompany.com/28905/brand-called-you
- https://hbr.org/2015/03/how-to-separate-the-personal-and-professional-on-social-media
- https://brandyourself.com/definitive-guide-to-personal-branding
- http://pwgmarketing.com/2008/10/what-does-branding-mean-to-you/
- https://cra.org/cra-w/wp-content/uploads/sites/5/2015/05/Building-Your-Professional-Persona.pdf
- https://www.inc.com/marc-ecko/be-a-brand-not-a-label.html
- https://www.inc.com/marc-ecko/be-a-brand-not-a-label.html
- https://www.youtube.com/watch?v=rGbsb6aXbzc

**Course Name - Software Foundation & Programming I**
**Course Code - CSESP101**
**Credits – 4**

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

**Syllabus (Theory):**

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

**Course Name - Software Foundation & Programming II**
**Course Code – CSESP201**
**Credits -- 4**

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

**<u>Syllabus (Theory):</u>**

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CSE301 | Data Structures | 3 | 0 | 4 | 0 | 5 |

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

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

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

**Syllabus (Theory):**

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

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

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

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

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

## Syllabus (Practical):

1. To search an element in the array using Linear Search
2. To search an element in the 2-dimensional array using Linear Search.
3. To merge two sorted arrays into one sorted array.
4. To perform the following operation in Matrix
   1) Addition 2) Subtraction 3) Multiplication 4) Transpose
5. To perform following operation on strings using string functions
   1) Addition 2) Copying 3) Reverse 4) Length of String.
6. To search an element in the array using Iterative Binary Search.
7. 8To search an element in the array using Recursive Binary Search.
8. To implement Stack using array.
9. To implement Queue using array.
10. To implement Bubble Sort & Selection Sort.
11. To implement Insertion Sort & Quick Sort.
12. To implement Merge sort.
13. Write a program to create a Linked List and perform operations such as insert, delete, update and reverse.

## Textbook(s):

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

**Reference Book(s):**

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hop croft, Data Structures and Algorithms. Pearson Education, 2012
2. Introduction to Algorithms, Corman T.H., Leiserson, C.E., and Rivest, R.L., MIT Press, 2013. (Indian reprint: Prentice-Hall).
3. Data Structures and Algorithm Analysis in C,Weiss, Mark A:, A. W Int,. ed.,2nd ed., 2010

**Web Resource(s):**

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE306 | Digital Electronics | 3 | 1 | 2 | 0 | 5 |

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

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

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

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

**Digital system and binary numbers:** Signed binary numbers, binary codes, cyclic codes, error detecting and correcting codes, hamming codes.
**Gate-level minimization:** The K-map method up to five variables, don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc-Clusky method (Tabular method)
**Combinational Logic:** Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decimal adder, binary multiplier, magnitude comparator, decoders, encoders, multiplexers, demultiplexers
**Synchronous Sequential logic:** Sequential circuits, storage elements: latches, flip flops, analysis of clocked sequential circuits, state reduction and assignments, design procedure.
**Registers and counters:** Shift registers, ripple counter, synchronous counter, other counters.
**Memory and programmable logic:** RAM, ROM, PLA, PAL. Design at the register transfer level: ASMs, design example, design with multiplexers. Asynchronous sequential logic: Analysis procedure, circuit with latches, design procedure, reduction of state and flow table, race Free State assignment, hazards.

**<u>Course Syllabi (Practical):</u>**

1. Study of logic gates.
2. Design and implementation of adders and subtractors using logic gates.
3. Design and implementation of code converters using logic gates.

4. Design and implementation of 4-bit binary adder/subtractor and BCD adder using IC 7483.
5. Design and implementation of 2-bit magnitude comparator using logic gates, 8-bit magnitude comparator using IC 7485.
6. Design and implementation of 16-bit odd/even parity checker/generator using IC 74180.
7. Design and implementation of multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154.
8. Design and implementation of encoder and decoder using logic gates and study of IC 7445 and IC 74147.
9. Construction and verification of 4-bit ripple counter and Mod-10/Mod-12 ripple counter.
10. Design and implementation of 3bit synchronous up/down counter.
11. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops

**<u>Textbooks:</u>**


1. M. Morris Mano and M. D. Ciletti, “Digital Design”, 4th Edition, Pearson Education
2. Pedroni - Digital Electronics & Design, Elsevier


**<u>Reference Books:</u>**


1. F. Vahid: Digital Design: Wiley Student Edition, 2006
2. J. F. Wakerly, Digital Design Principles and Practices, Fourth Edition, Prentice-Hall, 2005.
3. R. L. Tokheim, Digital electronics, Principles and applications, 6th Edition, Tata McGraw Hill Edition.

**Course Name - Object Oriented Programming Using JAVA**
**Course Code – CSESP301**
**Credits -- 5**

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

**<u>Syllabus (Theory):</u>**

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| **CSE304** | **Application Development** | 3 | 1 | 2 | 0 | 5 |

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

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

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

## Syllabus (Theory):

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

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

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

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

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

**Syllabus (Practical):**

Experiment 1 (HTML Page)

I. (a) Create a webpage with HTML describing your department. Use paragraph and list tags.

(b) Apply various colors to suitably distinguish key words. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.

(c) Create links on the words e.g. "Wi-Fi" and "LAN" to link them to Wikipedia pages.

(d) Insert an image and create a link such that clicking on image takes user to other page.

(e) Change the background color of the page. At the bottom create a link to take user to the top of the page.

Experiment 2 (Tables)

I. (a) Create a table to show your class timetable.

(b) Use tables to provide layout to your HTML page describing your university infrastructure.

(c) Use <span> and <div> tags to provide a layout to the above page instead of a table layout.

(d) Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks.

(e) Embed Audio and Video into your HTML web page.

Experiment 3 (CSS)

I. (a) Apply in-line CSS to change colors of certain text portion, bold, underline and italics certain words in your HTML web page. Also change background color of each paragraph using in-line CSS.

(b) Write all the above styling in CSS in different file (.css) and link it to your webpage such that changes made in CSS file are immediately reflected on the page. Group paragraphs into single class and add styling information to the class in CSS.

(c) Create a simple form to submit user input like his name, age, address and favorite subject, movie and singer.

(d) Add few form elements such as radio buttons, check boxes and password field. Add a submit button at last.

Experiment 4 (JavaScript)

I. (a) Create a form like the one in previous experiment. Put validation checks on values entered by the user using JavaScript (such as age should be a value between 1 and 150).

(b) Write a JavaScript program to display information box as soon as page loads.

(c) Write a JavaScript program to change background color after 5 seconds of page load.

(d) Write a JavaScript program to dynamically bold, italic and underline words and phrases based on user actions.

(e) Write a JavaScript program to display a hidden div (e.g. showing stats of a player when user clicks on his name).

Experiment 5 (CGI)

I. (a) Create a form using CGI-PERL paradigm, preferably as close to the one in experiment 3 as possible.

(b) Write CGI program to encode form and submit it.

(c) Write CGI program to decode the form you encoded previously and fetch the details submitted by user.

(d) Write CGI program to process the form details and show them back to the user.

(e) Using the concepts from above 4 steps, create a simple calculator.

Experiment 6 (Validator)

I. (a) Write a simple HTML code incorporating simple tags, list and div. Try validating it on validator.w3.org

(b) Add suitable header tags and format according to the validator. Validate it successfully.

(c) Add CSS file to style your document. Revalidate it using validator.

(d) Add links, images and tables. Revalidate it using validator.

(e) Add your own XML tags. Revalidate it using validator.

**<u>Text Book(s):</u>**


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

**Reference Book(s):**


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


**Web Resource(s):**

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

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

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

**<u>Syllabus (Theory):</u>**

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

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

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

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

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

**Textbook(s):**

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

**Reference Book(s):**

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

**Web Resource(s):**

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

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2" colspan="4">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
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<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="5">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test – I</td><td>Mid Term Test – II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks**</td><td>Mid Term Test-I</td><td>End Term Test</td><td colspan="2">Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks **</td></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td colspan="2">30</td><td>100</td></tr>
</table>

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

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

**Syllabus (Theory):**

**UNIT I:** BASIC STRUCTURE OF COMPUTERS: Functional units, Basic operational concepts, Bus structures, Performance and metrics, Instructions and instruction sequencing, Hardware, Software Interface, Instruction set architecture, Addressing modes **(Self Study)**, RISC, CISC. ALU design, Fixed point and floating-point operations.

**UNIT II:** BASIC PROCESSING UNIT: Fundamental concepts, Execution of a complete instruction **(Self Study)**, Multiple bus organization, Hardwired control, Micro programmed control, Nano programming.

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

**UNIT IV:** MEMORY SYSTEM: Basic concepts, Semiconductor RAM, ROM, Speed, Size and cost **(Self Study)**, Cache memories, Improving cache performance, Virtual memory, Memory management requirements, Associative memories, Secondary storage devices.

**UNIT V:** I/O ORGANIZATION: Accessing I/O devices, Programmed Input/Output, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB **(Self Study)**), I/O devices and processors.

## Syllabus (Practical):

1. Unit/ Title
2. Ripple Carry Adder
3. Carry-look-ahead adder
4. Registers and Counters
5. Wallace Tree Adder Design
6. Combinational Multipliers Design
7. Booth's Multiplier Design
8. Arithmetic Logic Unit Design
9. Memory Design
10. Associative cache Design
11. Direct Mapped cache Design
12. CPU Design

## Textbook(s):

1. William Stallings, "Computer Organization and Architecture, Designing for Performance", Seventh Edition, Pearson Education, 2012.

## Reference Book(s):

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Third Edition, Elsevier, 2005.
2. John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.
3. V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.

## Web Resource(s):

http://nptel.ac.in/courses/106103068/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| MA403 | Engineering Optimizations | 3 | 0 | 2 | 0 | 4 |

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

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

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

**Syllabus (Theory):**

**UNIT I:** LINEAR PROGRAMMING PROBLEMS: Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem

**UNIT II:** NON-LINEAR PROGRAMMING PROBLEMS: Introduction, Single variable and multi variable optimization, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming

**UNIT III:** PROJECT AND SIMULATION: Simulation, Project Management with CPM/PERT

**UNIT IV:** OPTIMIZATION MODELS: Basic structure of queuing models, role of the exponential distribution, The birth and death processes, queuing models based on birth and death processes (M/M/1 Model), , Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, Two jobs and m Machines Problems

**UNIT V:** NETWORK OPTIMIZATION MODELS: The Terminology of Networks, Shortest-Path Problem, Minimum Spanning Tree Problem, Case Study

**Syllabus (Practical):**

1. Problem solving using various software packages for the following areas.
2. Linear Programming
3. Non-linear Programming

4. Network Optimization
5. Case Study

**Textbook(s)/Reference Book(s):**


1. S S Rao, Engineering Optimization: Theory and Practices, New Age International, 1996.
2. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.
3. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2003.
4. Ronald L. Rardin, Optimization in Operations Research. Pearson Education, First Indian Reprint 2002.
5. Pant. J.C., Introduction to Optimization: Operations Research, Jain Brothers, 5th Ed., 2000.
6. Sharma. S. D., Operations Research, Kedarnath Ramnath & Co., 15th Edition, 2006.
7. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, PHI.
8. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.


**Web Resource(s):**

http://nptel.ac.in/courses/111105039/

<table>
<tr><th rowspan="2" colspan="2">Course code</th><th rowspan="2" colspan="4">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="2">CSE401</td><td colspan="4">Database Management Systems</td><td>3</td><td>1</td><td>2</td><td>0</td><td>5</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="4">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test – I</th><th>Mid Term Test – II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test-I</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks **</th></tr>
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</table>

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

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

**Syllabus (Theory):**

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

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

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

**UNIT IV:** Structure of Relational Databases (Basic Structure, Database Schema, Types of Keys), Fundamental Relational Algebra Operations (Select, Project, Union, Set Difference, Cartesian Product and Rename Operator), Additional Relational Algebra

Operators (Set Intersection, Natural Join, Division Operator, Assignment Operator), Examples

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

**Syllabus (Practical):**

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

**Text Book(s):**

1. Silberschatz, Korth, Sudarshan, “Database System Concepts”, 5th Edition, McGraw Hill Publication

**Reference Book(s):**

1. C J Date, A Kannan, S Swaminathan, “An Introduction to Database Systems”, 8th Edition, Pearson Education (2006)
2. S K Singh, “Database Systems: Concepts, Design and Applications”, Pearson Education

3. Elmsari, Navathe, “Fundamentals of Database Systems”, 5th Edition, Pearson Education (2008)
4. Peter Rob, Carlos Coronel, “Database Systems: Design, Implementation and Management”, 7th Edition, Cengage Learning (2007)

**Web Resource(s):**

http://nptel.ac.in/courses/106106093/

**Course Name - Information Management Basics**
**Course Code – CSESP401**
**Credits -- 5**

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

**Syllabus (Theory)**

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

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CSE501 | Operating Systems | 3 | 0 | 2 | 0 | 4 |

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

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

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

**Syllabus (Theory):**

**UNIT I:** Basic Elements of Computer System, Processor Registers, Instruction Execution, Interrupts, The Memory Hierarchy, Cache Memory, Operating System Objectives and Functions, The Evolution of OS, Major Achievements, Characteristics of Modern OS, Types of OS

**UNIT II:** Process States, Process Description, Process Control, Processes and Threads, Uni-processor Scheduling: Types of Scheduling, Scheduling, Algorithms, Traditional UNIX Scheduling

**UNIT III:** Principles of Concurrency, Mutual Exclusion, Software Approaches, Mutual Exclusion: Hardware Support, Semaphores, Monitors, Message Passing, Reader/Writer Problem, Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem,

**UNIT IV:** Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Segmentation with Paging

**UNIT V:** I/O Management, Disk Scheduling: I/O Devices, Organization of the I/O Function, OS Design Issues, I/O Buffering, Disk Scheduling, RAID, Disk cache, File Management Overview, File Organization, File Directories, File Sharing, Record Blocking, Secondary Storage Management.

**Syllabus (Practical):**

Linux Basics, File System, Commands in Linux, Pipes and Filters, Communication commands, Shell Scripting in Linux

**Textbook(s):**

1. Stalling W, “Operating Systems”, 6th edition, Prentice Hall India.
2. C.L. Liu, Elements of Discrete mathematics, McGraw-Hill, 1985

**Reference Book(s):**

1. Silberschatz, A., Peter B. Galvin and Greg Gagne, “Operating System Principles, Wiley India, 8th Edition
2. Tanenbaum A.S., “Modern Operating Systems”, 4th Edition, PHI, 2001
3. Flynn I.M, “Understanding Operating Systems”, Cengage India Publication

**Web Resource(s):**

http://nptel.ac.in/courses/106108101/

| | | |
|---|---|---|
| **Course Title and Code**<br>Computer Network: CSE503 | | |
| **Course Description**<br>This course introduces an understanding of the fundamental concepts of computer networking, layers of protocols and network technologies. It also incorporates the two fundamental models TCP/IP and OSI to understand the functional requirement of protocol architecture. This course also adds on the IoT to embed the various sensors on the network for efficient packet delivery and forwarding. This course is comprised of a lecture component that is used to develop the theoretical understanding of upper-layer protocols and network technologies, and a project-based learning component that is designed to develop the student's research, experimentation and analysis skills in a selected key networking area. | | |
| Prerequisites | | **Nil** |
| Hours per Week | | **L-T-P: 2-0-4 /In Class-Out Class: 6-12** |
| Credits | | **4** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | 12 |
| 03 | Class Participation | 00 |
| 04 | Quiz | 00 |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam(Final) | 30 |
| 08 | Report-1 | 0 |
| 09 | Report-2 | 0 |
| 10 | Report-3 | 0 |
| 11 | Project -1 | 15 |
| 12 | Project -2 | 25 |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | 08 |
| 15 | Lab Evaluation2(Final) | 10 |
| 16 | Course portfolio | 00 |
| | **Total (100)** | **100** |

**Syllabus**

**<u>Syllabus (Theory)</u>**

**UNIT I** Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Physical Layer Transmission Media, Switching methods, ISDN, Terminal Handling, Data Encoding. U**NIT II:** Concept of Multiplexing, Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols - Overview of IEEE standards. Data Link Layer - Elementary Data Link Protocols, Sliding Window protocols, Error Handling. **UNIT III:** Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control Internetworking -TCP / IP, IP packet, IP address, IPv6.**UNIT IV:** Transport Layer: Transport Layer - Design issues, connection management, TCP/UDP, Session Layer-Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, cryptography - TCP - Window Management. **UNIT V:** Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application. Example

Networks - Internet and Public Networks.

**Reference / Textbooks**

**Text Book(s)**


1. Forouzan, B. & Fegan, S. C. (2011). Data communication and networking (4th ed.). New Delhi: McGraw HIll.
2. Tanenbaum, A. S. & Wetherall, D. J. (2014). Computer networks (5th ed.). New Delhi: Pearson.
3. Stallings, W. (2014). Data and Computer Communications (9th ed.). New Delhi: Pearson


**Reference Book(s)**


1. Halsall, F. & Kulkarni, L. G. (2006). Computer Networking and the Internet (5th ed.). New Delhi: Pearson.
2. Forouzan, B. (2010). TCP/ IP protocol suite (4th ed.). New Delhi: McGraw Hill.
3. Misra, A. (2010). Computer networks. Acme Learning.
4. Shanmugarathia, G. (2009). Essential of TCP/ IP. New Delhi: Firewall Media.

**IM311: Basic Entrepreneurship**

<table>
<tr><td colspan="3">Course Title and Code<br><br>Basic Entrepreneurship (IM311) (Open Elective-I)</td></tr>
<tr><td colspan="3">Course Description<br>This is an open course for all the IInd Year management students and IIIrd Year Engineering Students. It is one of the fastest growing subjects in colleges and universities across the world. It has been identified as one of the major trends shaping business, economy and even society. This course is about creating, managing and leading an entrepreneurial organisation. It would enable students to start dreaming big, visualizing and working towards the realization of their dreams. The programme imparts essential knowledge of how to start one's own business venture and the various facets that influence successful set up and operations. The teaching/ learning of entrepreneurship require greater focus on experiential learning. Engagements such as interactive sessions, cases, games, exercise, role plays, films, projects, assignments, simulation and group activities play a vital role in teaching this course. This course is supported by Wadhwani Foundation and facilitated through Learnwise.</td></tr>
<tr><td colspan="2">Prerequisites</td><td>N.A.</td></tr>
<tr><td colspan="2">Hours per Week</td><td>L-T-P: 3-0-0 /InClass-OutClass: 2-1</td></tr>
<tr><td colspan="2">Credits</td><td>3</td></tr>
<tr><td>Sr. No</td><td>Specifications</td><td>Marks</td></tr>
<tr><td>01</td><td>Attendance</td><td>Nil</td></tr>
<tr><td>02</td><td>Assignment</td><td>10</td></tr>
<tr><td>03</td><td>Class Participation</td><td>10</td></tr>
<tr><td>04</td><td>Quiz</td><td>Nil</td></tr>
<tr><td>05</td><td>Theory Exam</td><td>Nil</td></tr>
<tr><td>06</td><td>MID TERM -2, Theory Exam</td><td>20</td></tr>
<tr><td>07</td><td>END TERM Theory Exam</td><td>30</td></tr>
<tr><td>08</td><td>Report-1</td><td>Nil</td></tr>
<tr><td>09</td><td>Report-2</td><td>Nil</td></tr>
<tr><td>10</td><td>Report-3</td><td>Nil</td></tr>
<tr><td>11</td><td>Project -1</td><td>20</td></tr>
<tr><td>12</td><td>Project -2</td><td>Nil</td></tr>
<tr><td>13</td><td>Project -3</td><td>Nil</td></tr>
<tr><td>14</td><td>Lab Evaluation</td><td>Nil</td></tr>
</table>

| | | |
|---|---|---|
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| 17 | Presentation | 10 |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

Overview of Entrepreneur and Entrepreneurship, Get Started (Discover Yourself), Identification of Idea/ Problem, Identify Customer and Craft Value Preposition, Business Model, Validation, Money (Revenue, Costs, Pricing and Financing), Team Building, Marketing and Sales, Support (Business Regulation), Project

**Reference Books and online source:**


1. Robert D Hisrich, Michael P Peters, Dean A Shepherd (2012). Entrepreneurship. New Delhi; Tata McGraw-Hill.
2. Poornima M Charantimath (2012). Entrepreneurship Development Small Business Enterprises. New Delhi: Pearson.
3. Rajeev Roy (2011). Entrepreneurship. New Delhi: Oxford
4. Learnwise.org

<table>
<tr><th rowspan="2" colspan="2">Course code</th><th rowspan="2" colspan="3">Course Title</th><th colspan="6">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th colspan="2">S</th><th>Credits</th></tr>
<tr><td colspan="2">ID504(Open Elective-I)</td><td colspan="3">Finite Element analysis</td><td>3</td><td>0</td><td>0</td><td colspan="2">0</td><td>3</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="6">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test – I</th><th>Mid Term Test – II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks**</th><th>Mid Term Test-I</th><th>End Term Test</th><th colspan="3">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks **</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td></td><td></td><td colspan="3"></td><td></td></tr>
</table>

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

**Syllabus (Theory):**

**UNIT I:** Introduction of FEA, Stress, and equilibrium. Boundary conditions, General description, Comparison of FEM with other methods. Nodes and elements, Meshing, Shape functions

**UNIT II: ONE–DIMENSIONAL FINITE ELEMENT ANALYSIS,** Bar Elements, Spring, Stiffness Matrix, Truss, Beam, Frame Elements

**UNIT III: Two–DIMENSIONAL FINITE ELEMENT ANALYSIS,** Introduction, Element Load Vector, Analysis of Plane and Beam, Axisymmetric Problems

**UNIT IV: FINITE ELEMENT METHODS,** Introduction of FEM, Formulation, Governing Equations, Steady state analysis of finite element model, Finite element methods, Applications

**UNIT V: COMPUTER IMPLEMENTATION OF FEM,** use of symmetry and anti-symmetry Conditions in reducing a problem, Computer Implementation, Storage Schemes, Applications of Boundary Conditions.

**Textbooks and Reference books:**


1. A. V. Hutton, Fundamentals of Finite Element Analysis, Mc Graw Hill, 2005.
2. Y. M. Desai, T.I. Eldho and A. H. Shah, Finite Element Method with Applications in Engineering, Pearson, 2011.
3. R. Dhanaraj and K. P. Nair, Finite Element Method, Oxford, 2015
4. P. Seshu, Textbook of Finite Element Analysis, PHI, 2004.

5. R. D. Cook, D. S. Malkus, M. E. Plesha and R. J. Witt. Concepts and Applications of Finite Element Analysis, Wiley, fourth edition.

**Web Resource(s):**

http://nptel.ac.in/courses/112106135/1

**Course code and Title: ECE510Microprocessor and Microcontroller** (Open Elective-I)
**Prerequisites**: Digital Electronics (ECE306)
**Course Objective**:

1. To enable student to realize the requirement of a processing unit in an electronic project.
2. To enable the student to be able to identify the tools required to develop the project.
3. To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems
4. To help student to develop an in-depth understanding of the operation of microprocessors and microcontrollers, high level language programming & interfacing techniques.
5. To assist the students with an academic environment aware of excellence guidelines and lifelong learning needed for a successful professional carrier

**Teaching Scheme & Credits**

| Hrs. Per Week | Credits | Duration in Weeks |
|---|---|---|
| L T P Out Class | 04 | 12 |
| 1 0 4 4 | | |

**Syllabus (Theory):**

Unit 1: Overview of microcomputer systems, Von Neumann and Harvard architectures, memory interfacing, concepts of Interrupts.
Unit 2: 8085 Microprocessor Architecture, Instruction set & Programming, 8255 I/O peripheral chip& interfacing.
Unit 3: 16-bit Microprocessor 8086 and its internal architecture, instruction set ,8086 interrupts, Comparison of microprocessors
Unit 4: Microcontrollers: ATmega 328 Architecture, Instruction Set, Hardware and Software Interfacing with AVR, Communication links with AVR, AVR system development tools and code development using high level language.
Unit 5: Introduction to ARM CORTEX M4F, architecture and advanced programming in C using APIs

**Textbooks:**


1. Ramesh S. Gaonkar, “Microprocessor Architecture, programming and applications with the 8085”, Penram International

2. Dhananjay V Gadre, Programming and Customizing the AVR microcontroller, Mc Graw Hill (India Edition), 2003.
3. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi, TITiva ARM Programming for Embedded systems, (www. Microdigitaled.com)

<table>
<tr><td colspan="2" rowspan="2">Course code</td><td colspan="2" rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td colspan="2">Credits</td></tr>
<tr><td colspan="2">PH501(Open Elective-I)</td><td colspan="2">Nanotechnology</td><td>3</td><td>0</td><td>0</td><td colspan="2">3</td></tr>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="4">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Examination– I (Marks /Weightage)</td><td>Mid Term Examination – II (Marks /Weightage)</td><td>End Term Examination (Marks/ Weightage)</td><td>Internal Assessment (Marks/ Weightage)</td><td>Total (Marks/Weightage)</td><td>Mid Term Examination (Marks/Weightage)</td><td>End Term Examination (Marks/ Weightage)</td><td>Internal Assessment (Marks/Weightage)</td><td>Total (Marks /Weightage) **</td></tr>
<tr><td>40/20%</td><td>40/20 %</td><td>80/40%</td><td>40/20%</td><td>200/100%</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

*Internal Assessment: Mini project/Quizzes/Assignments/Presentations/Practical Records/Mock Interviews/others

**Course Description:**

This course will provide understanding of science behind the properties exhibited by materials at nanoscale. The course introduces several advanced concepts and topics in the rapidly evolving field of nanotechnology. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications.

**Syllabus (Theory):**

**Unit 1: Band structure, Density of States and Behavior at Nanoscale**

Energy bands, Direct band gap and Indirect band gap, Density of states at low dimension structures, Optical Properties: Absorption/Reflection/Transmission coefficient, Tauc relation, Electrical transport phenomenon in metals, semiconductors and insulators, Mechanical properties

**Unit 2: Introductory Quantum Mechanics for Nanoscience**

Size effects in smaller systems, Quantum behavior at nanomaterials, de Broglie hypothesis, uncertainty principle, Schrodinger equations, Quantum confinement, Quantum wells, quantum wires and quantum dots Systems.

**Unit 3: Growth techniques of Nanomaterials**

Bottom-up approach vs Bottom-down approach, Lithographic vs Non-lithographic techniques, Thermal deposition/Sputtering, Chemical vapor deposition, E-beam Lithography/Screen printing, Ball Milling.

**Unit 4: Nanoscale Characterization Techniques**

X-ray diffraction (XRD): size, strain analysis, Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM).

**Unit 5: Novel materials and applications**

Carbon nanostructures (Carbon Nanotubes, Graphene, Fullerenes etc), Semiconducting nanomaterials, Nanocomposites, Device fabrication for energy storage, smart sensors, solar cells etc.

**Pre-requisite:**

Knowledge of basic science

**Reference Books:**


1. Nanoscience and Nanotechnology, M.S. Ramachandra Rao, Wiley, 2016
2. Charles Poole and Frank Owens, Introduction to Nanomaterials, Wiley 2007
3. Nanotechnology: Principles and Practices, Sulbha Kulkarni, Springer 2015
4. Handbook of Nanotechnology, Bharat Bhusan, Springer 2017
5. Nano-technology- Molecularly Designed Materials, G. M. Chow & K. E. Gonsalves, (American Chemical society).

| | | |
|---|---|---|
| **Course Title and Code:** Computing Using Python: CSE555 | | |
| **Course Description**<br>In this computer science course, students will learn about foundational computing principles, such as how to write and read computer code and how to run and debug code. Students will learn about general principles of programming like procedural programming, control structures, and data structures in Python. Demonstration of computing principles and domain applications that use programming concepts and computing principles in real applications would be done in this course. | | |
| Prerequisites | | **Nil** |
| Hours per Week | | **L-T-P: 2-0-4** |
| Credits | | **4** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | 20 |
| 03 | Class Participation | 10 |
| 04 | Quiz | Nil |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | Nil |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 20 |
| 12 | Project -2 | 20 |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | 30 |
| 15 | Lab Evaluation2(Final) | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus:**

gitHub, Functions, Booleans and Modules, Sequences, Iteration and String Formatting, Dictionaries, Sets, and Files, Exceptions, Testing, Comprehensions, advanced Argument Passing, Data Frames, Libraries , Lambda -- functions as objects, Object Oriented Programming, More OO -- Properties, Special methods, Iterators, Iterables, and Generators, Decorators, Context Managers, Regular Expressions

**Reference / Textbooks:**


1. William Punch, Richard Enbody, 'The Practice of Computing Using Python' Pearson, 2016
2. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, No Starch Press
3. Mark Lutz, Learning Python, O'Reilly,2013

**Course Name - Enterprise Reporting Using Business Intelligence**
**Course Code – CSEBD501 (Big Data & Analytics)**
**Credits -- 4**

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

**Syllabus (Theory):**

Changing Business with Data, Insight Turning data into information, Building the data warehouse, Accessing the data warehouse, Overview of IBM COGNOS 10.2, BI Identify Common, Data Structure Gather Requirements, Creating a Baseline Project, Introduction to the Reporting Application, Focus Reports using Prompts, Extend Reports using Calculations, Customize Reports with Conditional Formatting, Drill Through From One Report to Another, Create a Report using Relational Data.

**Course Name - Enterprise Application Development using Java**
**Course Code – CSESP501 (Cloud Computing and Information Security)**
**Credits -- 4**

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

**Syllabus (Theory)**

Introduction to Java EE Web Component, Overview of Servlets, Java EE Perspective of the Rational Application Developer, Java EE Container Services Overview, Servlet API, Library Case Study, Overview of JavaServer Pages, JavaServer Pages Specification and Syntax, Page Designer in Rational Application Developer, Debugging Web Applications, Web Archive Deployment Descriptor, Session State Storage Issues, Cookie API, HttpSession: Management of Application Data, URL Rewriting, Best Practices for Session Management, JavaBeans and the MVC Pattern, JavaServer Pages with JavaBeans, JSP Expression Language, JSP Custom Tags, JSP Tag Files, Servlet Filtering, Servlet Listeners, Best Practices for Server-Side Application Development, Java EE Packaging and Deployment, Installing an application in WebSphere Application Server V7.0, Web Application Security.

| | | |
|---|---|---|
| **Course Title and Code: Design & Analysis of Algorithms** CSE602 | | |

**Course Description**: This course introduces an understanding of the design and analysis of algorithm. The course demonstrates a familiarity with major algorithms and data structures and analyze the asymptotic performance of algorithms. It applies important algorithmic design paradigms and methods of analysis and synthesize efficient algorithms in common engineering design situations.

**Learning Outcome**

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

1. Analyze the complexity of different algorithms using asymptotic analysis.
2. Analyze and select an appropriate data structure for a computing problem.
3. Differentiate between different algorithm designs technique: Divide and Conquer Technique, Greedy, Backtracking, and Dynamic Programming. Also explain when an algorithmic design situation calls for using these.
4. Develop algorithm and programs using Divide and Conquer technique to solve various computing problems, e.g., Sorting, Strassen's matrix multiplication, and Closest pair.
5. Develop energy efficient algorithms and programs using Greedy approach to solve various computing problems, e.g., Minimum Spanning Trees, Shortest Path, Knapsack, Job scheduling, Graph colouring etc.
6. Develop algorithms and programs using Backtracking technique to solve various computing problems, e.g., N queen, M-coloring, Hamiltonian Cycle detection, Travelling salesman, and Network flow.
7. Develop algorithms and programs using Dynamic Programming technique to solve various computing problems, e.g., Knapsack, Shortest path, Coinage, Matrix Chain Multiplication, Longest common subsequence.
8. Apply Query optimization algorithms using Greedy and Dynamic programming approaches.
9. Apply various search-based problem-solving methods e.g., Uninformed search (BFS, DFS, DFS with iterative deepening), Heuristics, and Informed search (hill-climbing, generic best-first, A*).
10. Evaluate and apply appropriate energy efficient algorithmic design technique for solving complex computing problem.
11. Explain the ways to analyze randomized algorithms (expected running time, probability of error).
12. Apply differentiation between P, NP, NP-Complete, and NP-Hard problems.

| | | |
|---|---|---|
| Prerequisites | | **Nil** |
| Hours per Week | | **L-T-P: 2-0-2 (Out Class-4) (Weeks-12)** |
| Credits | | **3** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |

| | | |
|---|---|---|
| 02 | Assignment | 10 |
| 03 | Class Participation | Nil |
| 04 | Quiz | 10 |
| 05 | Theory Exam (Mid Term) | 15 |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | 30 |
| 08 | Report-1 | 0 |
| 09 | Report-2 | 0 |
| 10 | Report-3 | 0 |
| 11 | Project -1 | 0 |
| 12 | Project -2 | 25 |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation (Final) | 10 |
| 15 | Course portfolio | 00 |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

**UNIT I:** Introduction: Algorithms, Analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Types of approaches,
**UNIT II:** Selection sort, Bubble sort, Insertion Sort, Shell sort, Quick sort, Merge sort, Heap sort, sorting in linear time: Radix sort, Counting Sort, Comparison of sorting algorithms, Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching
**UNIT III:** Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms.
**UNIT IV:** Dynamic programming with examples such as Knapsack, All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem, Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, Hamiltonian Cycles and Sum of subsets.
**UNIT V:** Selected Topics: String Matching, Huffman Coding, Theory of NP-completeness, Approximation algorithms and Randomized algorithms.

**Textbook(s):**

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

**Reference Book(s):**

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

<table>
<tr><td colspan="2">Course code and name</td><td>Software EngineeringCSE604</td></tr>
<tr><td colspan="3">Course Objective:<br>In this course, students will gain a broad understanding of the discipline of software engineering and its application to the development and management of software systems.<br><br>Learning Outcomes:<br>On successful completion of CSE604 (Software Engineering) course, the students will be able to:<br>1. Use software development lifecycle models for project development.<br>2. Explain the advantages of agile software development over traditional software engineering methods.<br>3. Apply agile development method namely Extreme Programming (XP), Adaptive software development (ASD), Scrum and Crystal for software development.<br>4. Design solutions in various application domains using software engineering approaches that integrate ethical, social, economic and sustainability concerns.<br>5. Elicit and Evaluate functional and non-functional requirements for a software system.<br>6. Design represent and document software requirements specification according to IEEE standards.<br>7. Apply UML modelling for software design.<br>8. Apply coding standards and guidelines.<br>9. Prepare code checklist and perform code inspections, code reviews and walkthrough.<br>10. Develop and implement various manual and automated testing procedures.<br>11. Estimate the cost of software project.<br>12. Evaluate software in terms of software quality and quality assurance according to ISO standards.<br>13. Execute activities for software project such as re-engineering, reverse engineering and software configuration.</td></tr>
<tr><td colspan="2">Teaching Scheme (Hours per Week)</td><td>L T P (3 0 2)<br>Out Class-4 (Weeks-12)</td></tr>
<tr><td colspan="2">Credits</td><td>4</td></tr>
<tr><td colspan="2">Prerequisites</td><td>C Programming, C++ or Java programming, UML</td></tr>
<tr><td>Sr. No.</td><td>Evaluation Component</td><td>Marks</td></tr>
<tr><td>1</td><td>Attendance</td><td>NIL</td></tr>
<tr><td>2</td><td>Assignment</td><td>NIL</td></tr>
<tr><td>3</td><td>Class Participation</td><td>10</td></tr>
<tr><td>4</td><td>Quiz</td><td>NIL</td></tr>
</table>

| | | |
|---|---|---|
| 5 | Theory Exam-I | 20 |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 20 |
| 8 | Report | 10 |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project | 40 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | NIL |
| 15 | Lab Evaluation-II | NIL |
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**Syllabus (Theory):**

**Unit-1:** Basics, Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Software Development Life Cycle (SDLC) Models: Waterfall Model, Evolutionary Development Models, Incremental Process Model, Specialized Process Model, V-Model, An Agile view of process, Agile process models.

**Unit-2:** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

**Unit-3:** Basic Concept of Software Design, Architectural Design, Low Level Design, Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design methods and Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design.

**Unit-4:** Coding and Software Testing: Coding standards, programming style, code inspection, code review and walkthrough; Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-down and Bottom-up, Testing Strategies, Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products.

**Unit-5:** Software Measures, Metrics and Models: Various Size Oriented Measures, Hallstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures, Control Flow Graphs, Software metrics classification, Cost estimation models, Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO); Software quality and quality assurance, ISO standards; Software Re-engineering, Reverse engineering and Software Configuration.

**Reference Books:**


1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", 8th Edition, McGraw Hill Education (2014).
2. Sommerville, "Software Engineering", 10th Edition, Pearson Education (2015).
3. Waman S. Jawadekar, "Software Engineering – Principles and Practices", McGraw Hill Education.
4. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices", Pearson (2013).

| **Course Title and Code**<br>Integral Transforms: MA401(Open Elective-II) | |
|---|---|
| Hours per Week | **L-T-P: 3 0 2** |
| Credits | **3** |
| Students who can take | **B.Tech Semester-IV (Batch: 2017-21) and Semester-VI (Batch: 2016-20)/ Elective** |

**Course Objectives:**

This course has been designed to

1. Give students a thorough knowledge of various important integral transforms and a learning to recognize when, why, and how they are used.
2. Enable students to write various types of expansions like Sine, Cosine, Fourier, Legendre, Chebyshev, Wavelet etc. for a given function.
3. Enable students to construct the kernels of the integral transforms by solving the generalized Strurm-Liouville problems.

**Learning Outcomes:**

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

1. Construct the kernels of the integral transforms by solving the generalized Sturm-Liouville problems.
2. Identify various integral transforms and their applications through their kernels.
3. Characterize functions based on piecewise continuity, order and orthogonality.
4. Identify different types of wave forms.
5. Write various types of expansions like Sine, Cosine, Fourier, Legendre, Chebyshev, wavelet etc. for a given function.
6. Analyze fundamental characteristics of continuous time signals using various continuous transforms and discrete time signals using Discrete Fourier Transforms (DFT).
7. Apply various properties of transforms like change of scale and Convolution to study various types of signals.
8. Analyze small wavelets with limited duration using wavelet transform.
9. Evaluate function classes for their suitability to construct transforms.
10. Apply computational tools such as MATLAB to visualize the signal modulation.

| Sr. No | Specifications | Marks |
|---|---|---|
| 01 | Attendance | - |
| 02 | Assignment | 15 |
| 03 | Class Participation | - |
| 04 | Quiz | 05 |
| 05 | Theory Exam-I | 20 |
| 06 | Theory Exam-II | - |

| | | |
|---|---|---|
| 07 | Theory Exam-III | 30 |
| 08 | Report-I | - |
| 09 | Report-II | - |
| 10 | Report-III | - |
| 11 | Project-I | 15 |
| 12 | Project-II | - |
| 13 | Project-III | - |
| 14 | Lab Evaluation-I | - |
| 15 | Lab Evaluation-II | 15 |
| 16 | Course Portfolio | - |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

**Module I: Integral transforms**

Integral transforms, kernels of integral transforms, construction of kernels of the integral transforms, Properties of integral transform, Convolution theorem, different integral transform and their kernels.

**Module II: Fourier Integral and transforms**

Piecewise continuous functions, order of functions, Orthogonality of functions, special wave forms: Triangular wave, Square wave, Saw-tooth wave etc.

Euler's formulae, Complex exponential form for Fourier series, Half- and Quarter-Range Expansions. Fourier Integral, Fourier Transform, Transition from Fourier integral to Fourier Transform, Properties and applications.

Discrete Fourier transform: definition and interpretations, general properties

**Module III: Expansions and transforms**

Legendre polynomial, Legendre series expansion, Chebyshev polynomial, Chebyshev expansion, Wavelet function, Wavelet expansions. Continuous wavelet transforms. Time-frequency resolution.

**References:**


1. M. Ya. Antimirov, A. A. Kolyshkin and Remi Vaillancourt, Applied Integral Transforms, American Mathematical Society.
2. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003).
3. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).

4. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc
5. R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesley, 1998.
6. L. Prasad & S. S. Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

**Course Title and Code**
Theory of Computation: CSE504

| | |
|---|---|
| Hours per Week | **L-T-P: 3-0-0** |
| Credits | **3** |
| Students who can take | B.Tech Sem VI (2016-2020) Regular |

**Course Objective**: The course introduces fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. The course will enhance students' ability to understand and create mathematical models for computation and algorithms.

**Learning Outcome:**

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

1. For a given language determine whether the given language is regular or not.
2. Design and write programs for identification of patterns in linear textual data using the knowledge of tokens, regular expressions and regular languages.
3. Design context free grammars to generate strings of context free language.
4. Determine equivalence of languages accepted by Push down Automata and languages generated by context free grammars.
5. Compare different types of languages and abstract machines
6. To identify problems that cannot be solved by a particular abstract machine and suggest way to propose solutions.

| Prerequisites | | **Nil** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | NIL |
| 02 | Assignment | NIL |
| 03 | Class Participation | 10 |
| 04 | Quiz | NIL |
| 05 | Theory Exam-I | 20 |
| 06 | Theory Exam-II | NIL |
| 07 | Theory Exam-III | 20 |
| 08 | Report | 10 |
| 09 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project | 40 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | NIL |
| 15 | Lab Evaluation-II | NIL |

| | | |
|---|---|---|
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**Syllabus (Theory):**

**UNIT I:** Introduction; Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transit ion, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem

**UNIT II:** Regular expression (RE), Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non-Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

**UNIT III:** Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation , Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs,

**UNIT IV:** Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA

**UNIT V:** Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory

**Reference Books:**

1. Mishra, K. L. P., and N. Chandrasekaran. Theory of Computer Science: Automata, Languages and Computation. PHI Learning Pvt. Ltd., 2006.

2. Hopcroft, John E. Introduction to Automata Theory, Languages and Computation: For VTU, 3/e. Pearson Education India, 2013.
3. Martin, John C. Introduction to Languages and the Theory of Computation. Vol. 4. NY, USA: McGraw-Hill, 1991.
4. Lewis, Harry R., and H. Christor. "Papadimitrion: Elements of the theory of computation 2nd Ed." (1998): 247-250.

**Course Name - Predictive Analytics Modeler (Big Data & Analytics)**

**Course Code – CSEBD601**

Course Description-This course will introduce to some of the most widely used predictive modeling techniques and their core principles. This course will form a solid foundation of predictive analytics, which refers to tools and techniques for building statistical or machine learning models to make predictions based on data using IBM SPSS Modeler. This course will lead to exploratory data analysis to gain insights and prepare data for predictive modeling, an essential skill valued in the business.

Learning outcomes of course

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

1. Understand the importance of analytics and how it's transforming the world today.
2. Understand how analytics provided a solution to industries using real case studies
3. Explain what analytics is, the various types of analytics, and how to apply it
4. Improve efficiency, sample records, and work with sequence data
5. Explain data transformations, and functions
6. Understand modeling, relationships, derive and reclassify fields
7. Integrate and collect data
8. Understand the principles of data mining
9. Use the user interface of modeler to create basic program streams
10. Read a statistics data file into modeler and define data characteristics
11. Review and explore data to look at data distributions and to identify data problems, including missing values
12. Use the automated data prep node to further prepare data for modeling
13. User a partition node to create training and testing data subsets

Teaching Scheme and Credits

| Hrs. per Week | | Credits | Duration in Weeks |
|---|---|---|---|
| In Class | Out Class | | |
| 05 | 05 | 04 | 12 |

| **Sr. No** | **Specifications** | **Weightage (in percentage)** |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignment | 10 |
| 03 | Class Participation | Nil |
| 04 | Quiz | 5 |

| | | |
|---|---|---|
| 05 | Theory Exam – 1 | 10 |
| 06 | Theory Exam – 2 | Nil |
| 07 | Theory Exam – 3 | 25 |
| 08 | Report-1 (Case Study) | 10 |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 25 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation – 1 | 15 |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

Business Analytics Overview, Trends, Case Studies, Understanding Business Intelligence and Analytics, Introduction to Data Mining CRISP-DM, Nodes and streams, Initial data mining, storage and field measurement, Understanding the data (valid and invalid values),Integrating data (methods, options, merging, and sampling) Deriving and reclassifying fields (CLEM), Looking for relationships (matrix, distribution, means, histogram, statistics and plot), Functions (conversion, string, and statistical), Data transformation, Statistical, graphical and sample nodes, Automated data mining and modeling, Predictive models and customer segmentation.

**Course Name - Application Security** **<u>(Cloud Computing and Information Security)</u>**

**Course Code –CSECC601**

**Teaching Scheme and Credits**

| Hrs. per Week | | Credits | Duration in Weeks |
|---|---|---|---|
| In Class | Out Class | 4 | 18 |
| 5 | 10 | | |

**Course Description**: This course introduces Application Security concepts to the students. It introduces the IBM-AppScan Standard Software Tool to scan, analyze and report the web-application security vulnerabilities inherent in the coding and deployment of the web-applications. The course concludes with a project in which the learnings of the entire semester are applied in a scientific and coherent manner.

**Learning Outcome:**

After course completion, the student will be able to

1. Analyze the emerging threats and leaks as the world is becoming digitized.
2. Design and develop security dynamics for securing the enterprise application.
3. Analyze the IT security frameworks.
4. Design, Develop and Implement databases using RDBMS principles.
5. Develop and design code to work with select statements, DML statements, and multiple tables.
6. Design and Develop code to use joins in SQL.
7. Design and Develop website using HTML5 standard.
8. Design and Develop code using basics of JavaScript.
9. Analyze the web application security problems (the OWASP list) and web application basics.
10. Implement injection flaws, and SQL injection attack and the ways to mitigate these risks.
11. Implement broken authentication, and session management and the ways to mitigate these risks.
12. Implement cross-site scripting, insecure direct object reference, and security misconfiguration and the ways to mitigate these risks.
13. Analyze sensitive data exposer issues and missing functional-level access control attacks.
14. Implement cross-site request forgery (CSRF) and the ways to mitigate this risk.
15. Design and Develop a web-application in Java, ASP.NET, PHP or any other technology with Application–Security solutions applied to it- the theme of this

application will be based on the Sustainability Development Goals and it will follow the ACM coding standards.

16. Design and Develop a scan, review results, and reports using IBM AppScan and other open source web application scanning software tools.
17. Analyze and Evaluate how to log in and manage sessions, configure explore options, & optimize your scan.
18. Analyze glass box scanning, content-based scanning, and troubleshooting.

**Evaluation Scheme**

| **Sr. No** | **Specifications** | **Weightage (in percentage)** |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignment | 15 |
| 03 | Class Participation | 5 |
| 04 | Quiz | 10 |
| 05 | Theory Exam | 15 |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam | 25 |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 30 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation | Nil |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

Cyber Security Overview, Security Overview, Trends, Case Studies, Security standards and frameworks, Cyber Security Foundations , Application Security Technologies: HTML5 and JavaScript programming, SQL relational database, objects and tables, Application Security Engineer, Web application components and security issues, OWASP web application security attack classifications, SQL injection, Brute force authentication, Cross-site scripting (XSS), Insecure direct object reference, Security misconfiguration, Sensitive data exposure, Cross-site request forgery (CSRF), Vulnerability testing, scanning and threat modeling, Reporting threats and

Vulnerabilities, Glass Box testing, Scanning Web Services, Extend functions by using SDK and AXF, Troubleshooting IBM AppScan

| **Course Title and Code**<br>**CS1114: Advanced Data Structures and Algorithms** | |
|---|---|
| Hours per Week | **L-T-P: 3-0-2** |
| Credits | 4 |
| Students who can take | B.Tech. Odd Sem (VII) |

**Course Objective-**

- The course aims to develop deeper understanding about algorithm design paradigm and advanced data structures for solving complex algorithmic problems.

**Learning Outcome:**

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

- Argue the correctness of algorithms using inductive proofs and loop invariants.
- Analyse algorithms using amortized analysis (including the accounting method and the potential method) as required.
- Write program to solve algorithmic problems using divide-and-conquer paradigm.
- Write program to solve algorithmic problems using dynamic-programming paradigm.
- Implement variants of self-balancing tree.
- Analyse, implement and use heap structures.
- Analyse, implement and use hashing techniques.
- Apply and implement the disjoint set data structures to solve problems modelled by graph.
- Evaluate and apply appropriate energy efficient algorithmic design technique for solving complex algorithmic problem.

| Prerequisites | | **Nil** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignments | 10 |
| 03 | Class Participation | Nil |
| 04 | Quiz (4) | 10 |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | 20 |
| 07 | Theory Exam (Final) | 20 |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project-1 | Nil |
| 12 | Project-2 | Nil |
| 13 | Project-3 | Nil |
| 14 | Lab Evaluation1 | 20 |
| 15 | Lab Evaluation2(Final) | 20 |
| **16** | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory)** :

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

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

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

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

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

**Syllabus (Practical)**:

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

10. Write a program in C++ to implement KD tree and search the minimum in tree. Compare the running time complexity with minimum search in BST of similar elements.

11. Use C++/Python STL to implement Hash/Map/Dictionary for optimal searching.

**Textbooks:**


1. Samet, Hanan. Foundations of multidimensional and metric data structures. M. Kaufmann, 2006.
2. Mehlhorn, Kurt. "Sorting and Searching, volume 1 of Data Structures and Algorithms." (1984).
3. Mehta, Dinesh P., and Sartaj Sahni. Handbook of data structures and applications. Chapman and Hall/CRC, 2004.
4. Langsam, Yedidyah, Moshe Augenstein, and Aaron M. Tenenbaum. Data Structures using C and C++. Vol. 2. New Jersey: Prentice Hall, 2001.
5. Sartaj, Sahni. "Data Structures, Algorithms and Applications in C++." Computer Science, Singapore: McGraw-Hill (1998), reprint 2005.
6. Robert, L. Krune, Clovis L. Tondo, and Bruce P. Leung. "Data structures & Program Design in C." In O'Dougherty (production process staff workers) (second (hc) textbook ed.). Prentice-Hall, Inc. div. of Simon & Schuster, 2002.


**Reference Books:**


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

| Course Title and Code: Soft Computing: CS1202 | | |
|---|---|---|
| **Hours per Week** | | **L-T-P: 3-0-2** |
| Credits | | **4** |
| Students who can take | | Sem VII (2016-2020) |

**Course Objective:** This course introduces the fundamental concepts of soft computing techniques and their applications in building intelligent machines. The course will cover fuzzy logic, genetic algorithms, neural networks and their applications to handle uncertainty, optimization, classification and regression problems.

Learning Outcome:

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

1. Recognize the feasibility of applying a soft computing technique for a particular problem
2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3. Apply genetic algorithms to combinatorial optimization problems
4. Apply neural networks to pattern classification and regression problems
5. Effectively use existing software tools to solve real life problems using a soft computing approach

| Prerequisites | | Java or Python, DS, DAA |
|---|---|---|
| Sr. No | Specifications | Marks |
| 1 | Attendance | Nil |
| 2 | Assignment | Nil |
| 3 | Class Participation | 10 |
| 4 | Quiz | Nil |
| 5 | Theory Exam I | 10 |
| 6 | Theory Exam | Nil |
| 7 | Theory Exam (End Term) | 30 |
| 8 | Report-1 | Nil |
| 9 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 20 |
| 12 | Project -2 | 20 |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2 | 10 |
| 16 | Course portfolio | Nil |
| | Total (100) | 100 |

**Course Syllabi (Theory):**

- Introduction; Introduction to Soft Computing, Concept of computing systems. “Soft" computing versus "Hard" computing, Characteristics of Soft computing, applications of Soft computing techniques
- Introduction to Fuzzy logic. Fuzzy sets and membership functions, Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Applications of Fuzzy logic.
- Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures.GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs. Multi-objective Optimization Problem Solving. Concept of multi-objective optimization problems (MOOPs) and issues of solving them. Multi-Objective Evolutionary Algorithm (MOEA).
- Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving. Different ANNs architectures. Training techniques for ANNs. Applications of ANNs to solve some real-life problems.
- Deep Learning: Recurrent Neural Network TensorFlow, Convolution Neural Network, Application of Deep Learning

**References**:


1. Fuzzy Logic: A Practical approach, F. Martin, Mcneill, and Ellen Thro, AP Professional, 2000.
2. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
3. Genetic Algorithms in Search, Optimization and Machine Learning, David E. Goldberg, Pearson Education, 2002.
4. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
5. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
6. Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>CS1203 (Departmental Elective-1,2)</td><td>Block Chain Technology and Applications</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
</table>

**Syllabus (Theory):**

Introduction to Block chain History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols. Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains. Ethereum network, EVM, Transaction fee, Ether, gas, Solidity - Smart contracts, Truffle, Web3, Design and issue Cryptocurrency, Mining, DApps.
Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance. Blockchain in trade supply chain: Provenance of goods, visibility, trades supply chain finance, invoice management discounting, etc. Blockchain Cryptography. Research aspects I : Scalability of Blockchain consensus protocols, Case Study various recent works on scalability, Research aspects II : Secure cryptographic protocols on Blockchain, Case Study Secured Multi-party Computation, Blockchain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more, Coding and Documentation standards in Smart Contract Development. Energy saving programming practices.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CS1110 (Departmental Elective-1,2) | Artificial Intelligence and Machine Learning | 3 | 0 | 2 | 0 | 4 |

**Syllabus (Theory):**

Introduction to Artificial Intelligence, Intelligent Agents, Solving Problems by Searching, uninformed search, Informed search, Heuristics, Adversarial Search, Graph Pruning, Alpha-Beta Pruning, Min-Max Algorithm, Constraint Satisfaction Problems, First-Order Logic, Inference in First-Order Logic, Classical Planning, Planning and Acting in the Real World, Need of Representing and Reasoning Knowledge (Predicate, Prepositional and Fuzzy Logic)

Introduction to Machine Learning, Supervised and Unsupervised Learning, Simple and Multiple Linear Regression, Support Vector Regression, Decision Tree Regression, fitting dataset and evaluating their performance set, Evaluation of selected features, Model evaluation metrics, making predictions on new data

K-Nearest Neighbor, Support Vector Machine, Decision tree Classification Train/test split, Confusion matrix for evaluation, Class probabilities and class predictions, ROC Curve, Model evaluation metrics. Clustering; K-Means, Hierarchical Clustering, Introduction to artificial neural network

Applications of Artificial Intelligence and Machine Learning

Usage of AI and ML Techniques for achieving sustainable practices, NIST and IEEE standards for AI and ML libraries, tools and techniques

**Course Title**: Information Retrieval and Data Mining (CS1204)
**Prerequisite:** An understanding of probability and statistics, Proficiency in Java or Python programming.
**Course Description**: This course introduces an understanding of information retrieval and data mining techniques. It is about how to find relevant information and subsequently extract meaningful patterns out of it. While the basic theories and mathematical models of information retrieval and data mining are covered, the course is primarily focused on practical algorithms of textual document indexing, relevance ranking, web usage mining, text analytics, as well as their performance evaluations. Practical retrieval and data mining applications such as web search engines, business intelligence, and fraud detection will also be covered.
**Learning Outcomes**
On successful completion of this course, the students should be able to:
1. Develop and apply the algorithms and techniques for information retrieval (document indexing and retrieval, query processing, etc.).
2. Apply and modify the quantitative evaluation methods for the IR systems and data mining techniques.
3. Apply and modify the popular probabilistic retrieval methods and ranking principles.
4. Evaluate the effectiveness and efficiency of different information retrieval and data mining methods/techniques
5. Apply the techniques and algorithms existing in practical retrieval and data mining systems such as those in web search engines and business intelligence, and fraud detection.
6. Compare memory requirements of different search and indexing algorithms.
7. Apply standards like Porter stemming, Google Sitemap etc.

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

**Evaluation Scheme: -**

| **Course Title and Code**<br><br>**Information Retrieval and Data Mining (CS1204)** | | |
|---|---|---|
| | | |
| Prerequisites | | **Statistics, Java/Python** |
| Hours per Week | | **L-T-P: 3-0-2** |
| Credits | | **4** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | Nil |
| 03 | Class Participation | Nil |
| 04 | Quiz | 10 |
| 05 | Theory Exam (Mid Term) | 20 |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | 30 |
| 08 | Report-1 | 0 |
| 09 | Report-2 | 0 |
| 10 | Report-3/Term Paper | 10 |

| | | |
|---|---|---|
| 11 | Project -1 | 0 |
| 12 | Project -2 | 0 |
| 13 | Project -3 | 30 |
| 14 | Lab Evaluation (Final) | 00 |
| 15 | Course portfolio | 00 |
| | **Total (100)** | **100** |

**Syllabus**

**Syllabus (Theory)**

Overview of the fields**:** Study some basic concepts of information retrieval and data mining, such as the concept of relevance, association rules, and knowledge discovery. Understand the conceptual models of an information retrieval and knowledge discovery system

Indexing**:** Building an inverted index, Processing Boolean Queries, Ranked Retrieval**.** Document delineation and character sequence decoding, determining vocabulary of terms. Positional posting and phrase queries, dictionary retrieval, Index construction. Indexing Techniques, Parametric and Zone indexing, frequency and weighting, vector space model for scoring.

Retrieval Methods**:** Study popular retrieval models: Boolean, Vector space, Binary independence, Language modelling. Probability ranking principle. Other commonly used techniques include relevance feedback, pseudo relevance feedback, and query expansion

Mining Techniques**:** Mining class comparisons, Mining Association rules: single dimensional, boolean association rule, Apriori and FP-tree algorithm, Classification and prediction: issues, classification by decision tree induction, by back propogation, by association rule mining, Bayesian Text Classification, Vector Space Classification. KNN classifier, Linear Classifiers, Classification of documents using SVM model. Prediction, classifier accuracy. Cluster Analysis: introduction, type of data, clustering methods, Clustering in IR, evaluation of clustering, k-means, model-based learning, hierarchal clustering.

Google Sitemap standards for crawling, Porter stemming standards, Data Mining Group (DMG) standards for data mining. Design a sustainable approach of data collection of environmental data with minimal human resource.

## Text Book(s)

Manning, Christopher, Prabhakar Raghavan, and Hinrich Schütze. "Introduction to information retrieval." Cambridge University Press.

Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques” Third Edition, Morgan Kaufman Publisher

## Reference Book(s)

Ricardo Baea-Yates, Berthier Riberio-Neto “Modern Information Retrieval”, Pearson

Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Addison-Wesley, 2006

Gigabytes (2nd Ed.) Ian H. Witten, Alistair Moffat and Timothy C. Bell. (1999), Morgan Kaufmann, San Francisco, California.

Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer (2006)

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| CS1109 (Departmental Elective-1,2) | Theory of Computation and Compiler Design | 3 | 0 | 2 | 0 | 4 |

**Syllabus (Theory):**

Finite automata**:** Review of Automata, its types and regular expressions, Equivalence of NFA, DFA and €-NFA, Conversion of automata and regular expression, Applications of Finite Automata to lexical analysis.

Chomsky hierarchy of languages and recognizers, Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Context Sensitive features like type checking.

PDA and Parser**:** Push down automata, top down and bottom up parsing, YACC programming specification

Turing Machine**:** Turing Machine as language acceptors and its design, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP).

Code generation and optimization**:** Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code generation, type conversions, and equivalence of type expression, Code generation and optimization., ISO C++ standards published in 1998, and updated on 2014, The GNU coding standards, Energy aware computations

| | |
|---|---|
| **Course Title and Code**<br>**CS1112: Compiler Design** | |
| **Hours per Week** | **L-T-P: 3-0-2** |
| **Credits** | 4 |
| **Students who can take** | **B.Tech. Odd Sem (VII)** |
| **Course Objective-** This course aims to familiarize the students with the design of a compiler including its phases and components, develop a compiler. | |
| Learning Outcome:<br>On successful completion of this course, the students should be able to:<br>1. Specify and analyze the lexical, syntactic and semantic structures of programming language features<br>2. Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation<br>3. Write scanners, parsers, and semantic analyzers without the aid of automatic generators<br>4. Utilize the compiler design concept to write efficient programs<br>5. Design the structures and support required for compiling advanced language features. | |

| | | |
|---|---|---|
| Prerequisites | | **Nil** |
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignments | 10 |
| 03 | Class Participation | Nil |
| 04 | Quiz (4) | 10 |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam (midterm-II) | 20 |
| 07 | Theory Exam (Final) | 20 |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project-1 | Nil |
| 12 | Project-2 | Nil |
| 13 | Project-3 | Nil |
| 14 | Lab Evaluation1 | 20 |
| 15 | Lab Evaluation2(Final) | 20 |
| **16** | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

**UNIT I:** Introduction, Lexical analysis: Language processor, compiler, structure of a compiler, applications of Compiler technology, interpreter, cousins of a compiler, introduction to one pass & multipass compilers, Bootstrapping, Review of finite automata, Lexical analyzer, input buffering, Recognition of tokens, Lex: A lexical analyzer generator, Error handling

**UNIT II:** Syntax analysis: Review of context-free grammars (CFGs), Ambiguity of grammars, Taxonomy for parsing techniques, Top down parsing techniques: non-predictive or backtracking, recursive descent and non-recursive (LL) predictive parsing, bottom up (Shift reduce) parsing techniques: operator precedence parsing, LR (SLR, CLR and LALR) parsers, parsing with ambiguous grammar

**UNIT III:** Syntax directed definition and Intermediate Code Generation: Syntax-Directed definitions (SDDs): Evaluation order for SDDs; Applications of Syntax-directed translation; Syntax-directed translation schemes**,** Intermediate code generation**:** Variants of syntax trees; Three-address code; Types and declarations; Translation of expressions; Type checking; Control flow; Back patching; Switch statements; Intermediate code for procedures.

**UNIT IV:** Run time environments: Storage organization, Stack allocation of space, Access to non-local data on the stack, symbol table organization, Data structures used in symbol tables

**UNIT V:** Code generation: Basic blocks and Flow graphs, DAG (Directed Acyclic Graph) representation of basic block, Optimization of basic blocks, Issues in design of code generator, The Target language; Addresses in the target code, A simple code generator, Code generation from a DAG

**Syllabus (Practical):**

1 Program to implement a Deterministic Finite Automata.
2 Program for a lexical analyzer to recognize a few patterns in PASCAL and C.
3 Program to generate a lexical analyser using LEX.
4 Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
6 Program to recognize the grammar (anb n☐>=10)
7 Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
8 Program to develop a recursive descent parser.
9 Program to find FIRST of NON-TERMINALS of the given grammar
10 Program to find out FOLLOW of NONTERMINALS of given productions.
11 Program for generating for various intermediate code forms:
●Three address code●Quadruple

12 Program to generate the intermediate code in the form of Polish Notation.
13 Program to implement code optimization techniques to optimize given intermediate code (Three Address Code) form.
14 Program to Simulate Heap storage allocation strategy.

**<u>Textbook(s)</u>:**


1. K. Muneeswaran, Compiler Design, Oxford University Press, 2012


**<u>Reference Book(s)</u>:**


1. Compilers- Principles, Techniques and Tools, AlfredV Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman – 2nd Edition, Addison-Wesley, 2007.
2. Allen I. Holub "Compiler Design in C", Prentice Hall of India, 2003.
3. C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2003.


**<u>Web Resources</u>:**

http://nptel.ac.in/courses/106108052/1

| | | |
|---|---|---|
| **Course Title and Code:** | Big Data Analyst: CS1307 | |
| Hours per Week | **L-T-P: 3-0-2** | |
| Credits | 4 | |
| Students who can take | B.Tech Sem VII (IBM BDA & CC Specialization) | |

**Course Objective-** This course prepares students to use the Big Data platform and methodologies in order to collect and analyze large amounts of data from different sources. The students will acquire skills in Big Data architecture, such as Apache Hadoop, Ambari, Spark, Big SQL, HDFS, YARN, MapReduce, Zookeeper, Knox, Sqoop, and HBase.

**Learning Outcomes (Provided by IBM):**

After completing this course, the students should be able to understand the following topics:

1. Big Data and Data Analytics
2. Hortonworks Data Platform (HDP)
3. Apache Ambari
4. Hadoop and the Hadoop Distributed File System
5. MapReduce and YARN
6. Apache Spark, Storing and Querying data
7. Zookeeper, Slider, and Knox
8. Loading data with Sqoop, Data Plane Service
9. Stream Computing
10. Data Science essentials, Drew Conway's Venn Diagram
11. The Scientific Process applied to Data Science
12. The steps in running a Data Science project
13. Languages used for Data Science (Python, R, Scala, Julia, ...)
14. Survey of Data Science Notebooks, and Markdown language with notebooks
15. Resources for Data Science, including GitHub, Jupyter Notebook
16. Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, BeautifulSoup
17. Data visualizations: matplotlib, PixieDust
18. Using Jupyter "Magic" commands
19. Using Big SQL to access HDFS data, Creating Big SQL schemas and tables, Querying Big SQL tables, and Configuring Big SQL security
20. Data federation with Big SQL
21. IBM Watson Studio
22. Analyzing data with Watson Studio

| Prerequisites | | Linux, SQL |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | Nil |
| 02 | Assignment | Nil |
| 03 | Class Participation | 10 |
| 04 | Quiz | 05 |
| 05 | Theory Exam-I | Nil |
| 06 | Theory Exam-II (Certification Exam by | 25 |

| | | |
|---|---|---|
| | IBM) | |
| 07 | Theory Exam-III | 10 |
| 08 | Report-I | Nil |
| 09 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 30 |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| **16** | Course Portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus (Theory):**

Big Data Overview: Data Overview, Industry Applications, Case Studies, Understanding Big Data
Big Data and Analytics: Hortonworks Data Platform (HDP), Apache Ambari, Hadoop and the Hadoop Distributed File System, MapReduce and YARN, Apache Spark, Storing and Querying data, ZooKeeper, Slider, and Knox. Loading data with Sqoop, DataPlane Service, Stream Computing,
Data Science essentials, Drew Conway's Venn Diagram - and that of others, The Scientific Process applied to Data Science, The steps in running a Data Science project, Languages used for Data Science (Python, R, Scala, Julia, ...), Markdown language with notebooks, Resources for Data Science, including GitHub, Jupyter Notebook, Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, Beautiful Soup., Datavisualizations: matplotlib, PixieDust, Using Jupyter "Magic" commands,
Using Big SQL to access HDFS data, Creating Big SQL schemas and tables, Querying Big SQL tables, Configuring Big SQL security, Data federation with Big SQL,
IBM Watson Studio, Analyzing data with Watson Studio

**Reference Books:**


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

<table>
<tr><td colspan="2">Course Title and Code Security Intelligence: CS1308</td></tr>
<tr><td>Hours per Week</td><td>L-T-P: 3-0-2</td></tr>
<tr><td>Credits</td><td>4</td></tr>
<tr><td>Students who can take</td><td>B.Tech Sem VI(2017-2021) (CSE IBM-IS)</td></tr>
<tr><td colspan="2">Course Objectives: This course aims to provide comprehensive study of the principles and practices of computer system security including operating system security, network security, software security and web security. This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.</td></tr>
<tr><td colspan="2">Course Description: Topics include common attacking techniques such as virus, Trojan, worms and memory exploits; the formalisms of information security such as the access control and information flow theory; the basic cryptography, RSA, DES, AES, Diffie Hellman key Exchange, cryptographic hash function, and password system; this course introduces students the principles of network and operating system security through hands-on exploration. Students will learn how to harden an operating system as well as secure the network by implementing technologies such as firewalls, Virtual Private Networks (VPN), and Intrusion Detection Systems (IDS).<br>This course also covers the overall IBM QRadar ecosystem and shows how it is anchored at the center of an overall security immune system.</td></tr>
<tr><td colspan="2">Learning Outcome:<br>On successful completion of this course, the students should be able to:<br>1. Identify enterprise business and IT drivers that influence the overall IT Security Architecture<br>2. Define the role of a centralized Security Intelligence solution and how it integrates with other IT enterprise security components<br>3. Write an extensive analysis report on any existing security product or code, investigate the strong and weak points of the product or code<br>4. Develop SSL or Firewall based solutions against security threats, employ access control techniques to the existing computer platforms such as Unix and Windows NT<br>5. Explain how a Security Intelligence solution can be used to investigate and stop advanced threats and address IT governance and regulatory compliance<br>6. Describe how QRadar SIEM collects data to detect suspicious activities<br>7. Navigate and customize the QRadar SIEM dashboard<br>8. Investigate suspected attacks and policy breaches<br>9. Search, filter, group, and analyze security data<br>10. Investigate the vulnerabilities and services of assets<br>11. Locate custom rules and inspect actions and responses of rules<br>12. Use QRadar SIEM to create customized reports<br>13. Use charts and apply advanced filters to examine specific activities in your environment.</td></tr>
<tr><td>Prerequisites</td><td>Basics of Computer Networks</td></tr>
</table>

| Evaluation Scheme | | | |
|---|---|---|---|
| **Sr. No** | **Specifications** | **Marks (Old Scheme)** | **Marks (New Scheme)** |
| 1 | Attendance | Nil | Nil |
| 2 | Assignment | Nil | **10** |
| 3 | Class Participation | **10** | **10** |
| 4 | Quiz | **10** | **15** |
| 5 | Theory Exam-I | Nil | Nil |
| 6 | Theory Exam-II | **20** | Nil |
| 7 | Theory Exam-III (IBM Certification Exam) | **25** | **25** |
| 8 | Report-I | Nil | Nil |
| 9 | Report-II | Nil | Nil |
| 10 | Report-III | Nil | Nil |
| 11 | Project-I | **15** | **20** |
| 12 | Project-II | Nil | Nil |
| 13 | Project-III | Nil | Nil |
| 14 | Lab Evaluation-I | **10** | **10** |
| 15 | Lab Evaluation-II | **10** | **10** |
| 16 | Course Portfolio | Nil | Nil |
| | **Total (100)** | **100** | **100** |
| **Evaluation Scheme for Retest** | | | |
| 1 | Theory Exam-III | 25 | 30 |
| 2 | Lab Evaluation-II | 10 | 10 |
| | Total | **35** | **40** |

**<u>Syllabus (Theory):</u>**

**Module I – Cyber Security Overview**

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

**Module II – Information Security Algorithms**

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

**Module II – Security Intelligence Foundations**

Designing a Security Intelligence solution, Security Intelligence functional components

**Module III – Security Intelligence Engineer**

Collecting and processing events, flows, and vulnerability data, investigating an offense that is triggered by events, Investigating the events of an offense, using asset profiles to investigate offenses, investigating an offense that is triggered by flows, false positives

overview, investigating superflows, using rules and building blocks, creating SIEM reports, performing advanced filtering

**<u>Textbooks:</u>**

T1. Li, Qing, and Gregory Clark. Security Intelligence: A Practitioner's Guide to Solving Enterprise Security Challenges. John Wiley & Sons, 2015.

William Stallings, “Cryptography and Network Security: Principals and Practice”, Pearson Education.

Behrouz A. Forouzan: Cryptography and Network Security, TMH

Hsu, D. Frank, and Dorothy Marinucci, eds. Advances in cyber security: technology, operations, and experiences. Oxford University Press, 2012.

Geers, Kenneth. Strategic cyber security. Kenneth Geers, 2011.

**<u>Reference Books:</u>**

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

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

| Course code | Course Title | Teaching Scheme |
|---|---|---|

| | | L | T | P | S | Credits |
|---|---|---|---|---|---|---|
| **EEE610** | **Automation Projects** | **0** | **0** | **2** | **0** | **2** |

**Course Objectives:** The course will provide hands-on experience on Embedded systems and IoT. The students will be able to develop innovative projects using microcontrollers and upload the data to cloud server.

**Learning outcomes:**

On successful completion of this course, students should be able

1. Develop C programs on microcontroller for reading or writing to ports.
2. Interface sensors with microcontroller and read the sensor values in digital form.
3. Process the sensor values (for edge device) and transmit the results to server/users
4. Design printed circuit board layout and implement the hardware with optimum components with minimum energy consumption and cost.

**Assessment Scheme:**

| Sr. No | Specifications | Marks |
|---|---|---|
| 01 | Attendance | Nil |
| 02 | Assignment | Nil |
| 03 | Class Participation | Nil |
| 04 | Quizzes | 10 |
| 05 | Theory Exam | Nil |
| 06 | MID TERM Theory Exam | 20 |
| 07 | END TERM Theory Exam | 20 |
| 08 | Report -1 | Included with Project 1 |
| 11 | Project -1 | 50 |
| 15 | Lab Evaluation | Nil |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Syllabus:** Familiarization with MSP430 architecture and Code composer Studio, MSP430 Programming with C, Working with I/O ports, Interrupt handling, Signal Processing, Digital Communication with internal UART, SPI, IIC modules

| **Course Title and Code**<br>ID305: Competitive Programming | |
|---|---|
| Hours per Week | **L-T-P: 0-0-2** |
| Credits | **A** |
| Students who can take | B.Tech. Even Sem (IV, VI) |
| **Course Objective-** This Course is designed to equip learners with skills of computational problem solving with a focus on time and space efficiency. It includes analysis, selection, implementation, optimization and scalability of algorithms. | |
| **Learning Outcome:**<br>On successful completion of this course, the students should be able to:<br>1. Identify the algorithmic way of solving problem<br>2. Select an effective data structure and algorithm to efficiently solve the problem<br>3. Analyze Time and Space Complexity of Solution<br>4. Analyze Scalability of Solution<br>5. Attempt an online/onsite national/international computational problem-solving contest.<br>6. Organize an online/onsite national/international computational problem-solving contest/event<br>7. Adapt Ethical Coding Practices | |

| Prerequisites | | **Nil** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 01 | Attendance | 10 |
| 02 | Assignments | Nil |
| 03 | Class Participation | 10 |
| 04 | Quiz (4) | Nil |
| 05 | Theory Exam | Nil |
| 06 | Theory Exam | Nil |
| 07 | Theory Exam (Final) | Nil |
| 08 | Report-1 | Nil |
| 09 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project-1 | Nil |
| 12 | Project-2 | Nil |
| 13 | Project-3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2(Final) | Nil |
| **16** | Course portfolio | 80 |
| | **Total (100)** | **100** |

**Course Code and Name CSE755: Big Data and Future Technologies**

**Audit Course**

**<u>Syllabus:</u>**

Overview of Big Data – Definition, Measurement (Volume, Velocity, Variety), Usage. Differences from Open Data, Public/Proprietary Data, Trends in hardware & software industries shaping Big Data, Challenges of pursuing Big Data Strategy, identify potential data sources, People & Process: Skill-sets required, talent finding, manage talent, business process and set up for Big Data strategy, Financial impact & cost-benefit analysis, State of the art of Big Data Tools & Models. Big Data tools, selection of technologies and methodologies of Big Data analytics, Stages of new technology diffusion, perspectives of Big Data: Internal & External Big Data, Data Privacy, Information security: Importance, Investment and Implications, Social engineering, hacktivists and usage of advanced technologies such as IoT(botnets) for cyberwarfare, Stanford CoreNLP (Natural Language Processing): Basics and usage, Designing neural networks and using existing libraries for NLP algorithms, Text matching and sentiment analysis techniques, Uses of Big Data, Marketing to Operational strategy is affected and driven by Big Data, Smart decision making & Big Data impact on long-term strategic decisions, Exploration vs Exploitation of Big Data,

R Installation & Configuration, Basic of R programming – Origin, Usage and current progress, statistical analysis and graphics, R problem solving and large data structures, Compustat (Wharton Research Data Services) database, Usage of business understanding and frameworks to posit objectives, Regression analysis – OLS (Ordinary Least Square), GLM (Generalized Linear Models) & SEM (Structural Equation Models)

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE301 | Electronic Devices & Circuits | 3 | 0 | 2 | 0 | 4 |

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

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

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

## Syllabus (Theory):

**Semiconductor Physics:** Mobility and conductivity, charge densities in a semiconductor, Fermi Dirac distribution, carrier concentrations and Fermi levels in semiconductor, Generation and recombination of charges, diffusion and continuity equation, Mass action Law, Hall effect.
**Junction Diode:** PN Junction diodes, Diode as a circuit element, load line concept, clipping and clamping circuits, Voltage multipliers. Zener diode, characteristics and its applications.
**Bipolar Junction Transistor:** Transistor characteristics, Current components, Current gains: alpha and beta. Operating point. Hybrid model, h-parameter equivalent circuits. CE, CB and CC configuration. DC and AC analysis of CE, CC and CB amplifiers. Ebers-Moll model. Biasing & stabilization techniques. Thermal runaway, Thermal stability.
**Field Effect Transistor** JFET, MOSFET, Equivalent circuits and biasing of JFET's & MOSFET's. Low frequency CS and CD JFET amplifiers. FET as a voltage variable resistor. Biasing, Small signal model analysis.
**Small Signal Amplifiers at Low Frequency:** Analysis of BJT and FET, DC and RC coupled amplifiers. Frequency response, mid-band gain, gains at low and high frequency. Analysis of DC and differential amplifiers. Miller's Theorem. Cascading Transistor amplifiers, Darlington pair. Emitter follower, source follower.

## Syllabus (Practical):

1. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse saturation current and static & dynamic resistances.
2. Plot V-I characteristic of Zener diode and study of Zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
3. Study of application of diode as clipper & clamper circuit.
4. Plot input and output characteristics of BJT in CB, CC and CE configurations.

5. Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.
6. Plot drain current-drain voltage and drain current-gate bias characteristics of field effect transistor and measure of $I_{DSS}$ & $V_P$.
7. Plot gain-frequency characteristic of two stages RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.

**Text Books:**


1. Microelectronics Circuits (Theory and Applications), Adel S. Sedra and Kenneth C. Smith, Adapted by Arun N. Chandorkar, 5th Ed. Oxford International Student Edition.
2. Electronic Device and Circuits, J.B. Gupta, Katson Educational Series.
3. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar and A Vallavaraj, Tata Mc-Graw Hill 2rd Edition


**Reference Books:**


1. Millman's Electronic Devices and Circuits, Jocob Millman, Christos C Halkias & Satyabrata Jit, Tata Mc-Graw Hill 3rd Edition.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson 10th Edition.
3. Electronic Devices and Circuits, David A. Bell, Oxford 5th Edition.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE304 | Control Systems | 3 | 0 | 0 | 0 | 3 |

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

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

## Syllabus (Theory):

**INTRODUCTION TO CONTROL SYSTEM:** Open loop and closed loop systems, examples, components of control systems, types of control systems, concept of feedback, positive and negative feedback.

**MATHEMATICAL MODELING OF PHYSICAL SYSTEMS:** Modeling of physical systems such as mechanical, electrical, thermal and chemical systems, analogous systems, concept of transfer function, poles, zeros, order and type of the system, computation of overall transfer function, block diagram reduction techniques, signal flow graphs.

**TIME RESPONSE ANALYSIS:** Standard test signals, transient and steady state response of first and second order systems, time response specifications, types of systems, steady state error and error constants. Basic control action and automatic controllers, Effect of PI, PD and PID controllers on system performance.

**STABILITY ANALYSIS OF CONTROL SYSTEMS**: Notations of stability, Necessary conditions for stability, Routh-Hurwitz stability criterion, Relative stability, Basic properties of root locus, rules to construct root locus, stability analysis using root locus.

**FREQUENCY DOMAIN ANALYSIS:** Introduction to frequency response, frequency domain specifications, stability analysis using Bode plots, stability analysis using Polar and Nyquist plots.

**INTRODUCTION TO STATE SPACE:** Concept of state, state variables, state space modeling, conversion of state space equations to transfer function, solution of state equation, controllability and observability.

**DESIGN AND COMPENSATION:** Design consideration of control system, lead, lag, lead-lag compensation, Design of compensating network using bode plots and root locus.

**Text Book(s):**

1. I J Nagrath and M Gopal: Control Systems Engineering, 3rd Ed, New Age Publication.
2. B C Kuo: Modern Control Engineering, New Age Publication
3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Pvt. Ltd., New Delhi

**Reference Book(s):**

1. Robert H Bishop: Modern Control Systems, Boyd and Fraser pub
2. Norman S.Nise, “Control System Engineering”, John Wiley & Sons.
3. Gene F. Frankline, J. David Powell, Abbas Emami-Naeini, “Feedback Control of Dynamic Systems”,
   Pearson Education Inc., 2006

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE401 | Analog Electronics | 3 | 1 | 2 | 0 | 5 |

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

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

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

## Course Syllabi (Theory):

**Feedback Amplifiers:** Feedback concept and some properties of negative feedback, Four basic feedback topologies, Analysis of voltage-series, voltage-shunt, current-series and current-shunt feedback amplifier, Determining the loop gain, Stability criterion.

**Signal Generators and Waveform-Shaping Circuits:** Basic Principles of Sinusoidal Oscillators, Criterion for oscillation, RC Oscillator Circuits (Wien Bridge & RC Phase Shift), LC-Tuned Oscillator (Hartley & Colpitts), Crystal Oscillator, Sine Wave, Sawtooth Wave, Triangular Wave, Square Wave Generator, Astable, Monostable and Bistable Multivibrators.

**High Frequency Amplifiers:** Hybrid, Pi model, conductance and capacitances of hybrid, Pi model, high frequency analysis of CE amplifier, gain-bandwidth product. Emitter follower at high frequencies.

**Output Stage and Power Amplifiers:** Classification of output stage, Class A output stage, class B output stage and class AB output stage, class C amplifiers, Push-pull amplifiers with and without transformers. Complementary symmetry amplifiers and Quasi-Complimentary symmetry amplifiers.

## Syllabus (Practical):

1. Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1 KHz with and without negative feedback.
2. Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor.
3. Study of push pull amplifier, Measure variation of output power & distortion with load.
4. Study Wein bridge oscillator and observe the effect of variation in R & C on oscillator frequency.

5. Study transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.
6. Study the following oscillators and observe the effect of variation of C on oscillator frequency: (a) Hartley (b) Colpitts
7. Study of a Digital Storage CRO and store a transient on it.
8. To plot the characteristics of MOSFET and CMOS.
9. Design Fabrication and Testing of k-derived filters (LP/HP).

**Text Books:**


1. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Learning, 4th Edition.
2. Microelectronics Circuits (Theory and Applications), Adel S. Sedra and Kenneth C. Smith, Adapted by Arun N. Chandorkar, 5th Ed. Oxford International Student Edition.
3. Analog Electronics, L.K. Maheshwari and M.M.S Anand, PHI Learning, 6th Edition.


**Reference Books:**


1. Millman's Electronic Devices and Circuits, Jocob Millman, Christos C Halkias & Satyabrata Jit, Tata Mc-Graw Hill 3rd Edition.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson 10th Edition.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE408 | Engineering Signals & System | 3 | 1 | 2 | 0 | 5 |

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

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

## Course Syllabi (Theory):

**Signals and Systems**: Motivation and introduction to the course, Basic concepts of signals and systems, signal transformations, continuous and discrete time systems, basic systems properties.

**Linear time invariant (LTI) systems**: Discrete and continuous – time LTI systems, convolution, properties of LTI systems, system described by differential and difference equations.

**Fourier representation of periodic signals:** Representation of continuous time periodic signals and their properties, representation of discrete time periodic signals and their properties, Fourier series and LTI systems, filtering.

**Fourier Transform of aperiodic signals:** Continuous and discrete time Fourier transform, properties of transforms, convolution and multiplication property, duality, time-frequency characterization, sampling.

**Laplace and z-transform:** The Laplace and z-transform, region of convergence, properties, analysis and characterization of LTI system using Laplace and z - terization of LTI system using Laplace and z - transform.

Introduction to Sampling.

## Course Syllabi (Practical):

1. Introduction to MATLAB environment
2. Defining various variables and type conversion
3. Perform and plot basic arithmetic operation
    a. Addition, multiplication etc.
    b. Exponential, logarithmic etc.
    c. Trigonometry, complex numbers etc.
4. Working with arrays of numbers
    a. Basic mathematical operations

b. Matrices, circles.

5. Graph Plots:
   a. Sine plots
   b. Decaying and growing functions
   c. Overlay plots
6. Use of important library functions
7. Basic 2D and 3D plots, use of subplot
8. Programs to understand creation, saving, execution of files
9. Programs involving matrices, vectors, manipulations, linear algebra.
10. Amplitude modulation and demodlation

**Textbooks:**

1. Signals and Systems by Tarum Kumar Rawat, Oxford.

**Reference Books:**

1. Signals and Systems, Oppenheim, Willisky and Hamid Nawab, Prentice Hall, 2nd Ed.
2. Signals and Systems, S. Haykin and B. V. Veen, et al., Willey India, 2nd Ed.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE403 | Electromagnetic Field Theory | 3 | 1 | 0 | 0 | 4 |

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

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

**Course Syllabi (Theory):**

**Introduction:** Sources and effects of electromagnetic fields – Scalar and Vector fields – Different co-ordinate systems-vector calculus – Gradient, Divergence and Curl - Divergence theorem – Stoke's theorem.

**Time varying fields and Maxwell's equations:** Faraday's laws, induced emf – Transformer and motional EMF–Forces and Energy in quasi-stationary Electromagnetic Fields - Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

**Electromagnetic waves:** Generation – Electro Magnetic Wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors-skin depth, Poynting vector – Plane wave reflection and refraction – Transmission lines – Line equations – Input impedances – Standing wave ratio and power.

**Electromagnetic radiation:** Radiation from a current element in free space, Quarter and half wave antenna, Electromagnetic interference and electromagnetic compatibility. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization. Brewster angle.

**Textbook:**

1. Principles of Electromagnetics, N. O. Sadiku; Oxford Univ. Press, 4th Ed

**Reference Books:**

1. Engineering Electromagnetics, Hayt and Buck; TMH,7th Ed
2. Fundamentals of applied electromagnetics, F.T. Ulaby; PHI,5th Ed
3. Introduction to electrodynamics, D.J. Griffiths; PHI.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>ECE515</td><td>Digital Signal Processing</td><td>2</td><td>0</td><td>4</td><td>0</td><td>5</td></tr>
</table>

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

### Introduction to DSP:

Signals, systems and signal processing, classification of signals, Signal operations, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples.

### Discrete-Time Signals and Systems (Frequency Domain analysis):

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems; The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution; Relationship between Fourier and Z-transforms.

### Efficient Computation of the DFT: Fast Fourier Transform Algorithm

Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence.

### Implementation of Discrete-Time Systems:

Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures; Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

### Filter Design Techniques:

Filter Function Approximations and Transformations: Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II; Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques

**Textbooks:**

Digital Signal Processing Principles, Algorithms and Applications, J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.

**Reference Books**:

1. Digital Signal Processing: a Computer-Based Approach, Sanjit K. Mitra, TMH
2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.
3. Digital Signal Processing, Manson H. Hayes, Schaum's Outlines, TMH.
4. Digital Signal Processing: A Modern Introduction, Ashok K Ambardar, Cengage Learning.
5. Modern Digital Signal Processing, Roberto Cristi, Cengage Learning.
6. Digital Signal Processing: Fundamentals and Applications, Li Tan, Jean Jiang, Academic Press, Elsevier.
7. Digital Signal Processing: A MATLAB-Based Approach, Vinay K. Ingle and John G. Proakis, Cengage Learning.
8. Fundamentals of Digital Signal Processing using MATLAB, Robert J. Schilling and Sandra L. Harris, Cengage Learning.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE507 | Analog and Digital Communication | 3 | 0 | 2 | 0 | 5 |

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

**Syllabus (Theory):**

**Review of signals and systems**, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.
**Review of probability and random process**. Gaussian and white noise characteristics, Noise in Amplitude modulation systems, Noise in Frequency modulation systems. Threshold effect in angle modulation.
**Pulse modulation**. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation (DM), Noise in PCM and DM systems.
**Digital Modulation and Transmission:** Phase Shift Keying (PSK), Quadrature Amplitude Shift Keying (QAPSK), Frequency Shift Keying (FSK).

**Text/Reference Books:**


1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'', John Wiley, 1965.
1. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
2. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| **ECE609** | **Linear Integrated Circuits** | 3 | 0 | 2 | 0 | 5 |

**Course Objectives:** This course aims to help students to use various Linear Integrated circuits. The students will be able to develop electronics projects using components that use minimum power as well using IEEE standard for LSI-Package-Board Interoperable Design.

**Learning Outcomes**

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

1. Develop simple circuits without and with feedback using operational amplifiers.
2. Interpret datasheets for OP-AMPS, ADC, PLL, Voltage regulators, Voltage to Frequency, Frequency to voltage convertors, Opto-couplers and various linear ICs and to choose ICs with required functionality, sensitized with energy usage and effects on environment.
3. Design and implement signal processing circuits including active filters using operational amplifier.
4. Integrate analog sensors to ADC and switch matrix/actuators to DACs.
5. Generate various waveforms using DACs.
6. Design and implement application(s) using Phase Lock Loop IC.
7. Design and implement application on tuned amplifier.
8. Explain the working principle of linear ICs- Voltage to Frequency, Frequency to Voltage Convertor, Opt couplers, Voltage Regulators.
9. Refine the designs using a few key elements of IEEE standard for LSI-Package-Board Interoperable Design.
10. Review circuits using the International Technology Roadmap for Devices and Systems.

**Assessment Scheme**:

| Sr. No. | Evaluation Component | Marks |
|---|---|---|
| 1 | Attendance | Nil |
| 2 | Assignment | 10 |
| 3 | Class Participation | Nil |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I | 20 |
| 6 | Theory Exam-II | 20 |
| 7 | Theory Exam-III | Nil |
| 8 | Report-I | Nil |
| 9 | Report-II | Nil |

| | | |
|---|---|---|
| 10 | Report-III | Nil |
| 11 | Project-I | 25 |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab/Evaluation-I (Activities Evaluation) | 15 |
| 15 | Lab Evaluation-II | Nil |
| 16 | Course Portfolio | Nil |
| | **Total (100)** | |

**Course Syllabi (Theory):**

Operational Amplifiers: Op-amp Basics, Properties of Ideal Op-Amp, Inverting, Non-inverting, Summing, Difference amplifier, Voltage Follower, Current-to-Voltage Converter, and Characteristics of Practical Op-Amp, Effect of Non-ideal behavior on Op-Amp performance, Differentiator, Integrator, Exponential and logarithmic amplifier, Analog Multiplier, Precision Half wave and Full wave rectifiers, Clipper and Clamper, Peak Detector, Comparator and its applications, Schmitt Trigger.

Active Filters: Low pass, high pass, band pass and band reject filters, all-pass filter, Switched capacitor filter, Butterworth filter design, Chebyshev Filter design.

Phase Locked Loops: Operating Principles of PLL, Linear Model of PLL, Lock range, Capture range, Applications of PLL as FM detector, FSK demodulator, AM detector, frequency translator, phase shifter, tracking filter, signal synchronizer and frequency synthesizer, Building blocks of PLL, LM565 PLL.

Analog to Digital and Digital to Analog Convertors: Analog switches, High speed sample and hold circuits and sample and hold ICs, Types of D/A converter, Current driven DAC, Switches for DAC, A/D converter-Flash, Single slope, Dual slope, Successive approximation, Delta Sigma Modulation, Voltage to Time converters.

Special Function IC's: Four quadrant multiplier & its applications, Basic blocks of linear IC voltage regulators, Three terminal voltage regulators, Positive and negative voltage regulators, Frequency to Voltage converters, Voltage to Frequency converters, Tuned amplifiers, power amplifiers, Isolation Amplifiers, Video amplifiers, Fiber optic ICs and Opto-couplers.

**Textbooks:**

1. Gayakwad, Ramakant A. Op-amps and linear integrated circuit technology. Englewood Cliffs, NJ: Prentice-Hall, 1983.
2. Roy, D. Choudhury. Linear integrated circuits. New Age International, 2003.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **S** | **Credits** |
| **ECE731** | **Wireless Communication & Networks** | **3** | **0** | **0** | **0** | **3** |

**Course Objectives:** The goals of the course are to help students to understand the cellular communication fundamentals. It shall help students to know and compare the various wireless communication techniques.

**Learning Outcomes:**

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

1. Compare and contrast principles, standards, applications and challenges of various wireless communication generations, namely, 1G, 2G, 3G and 4G.
2. Explain fundamental concept related to wireless communication.
3. Explain cellular communications, channels and mobile radio propagation.
4. Explain Digital Signaling methods for different fading channels.
5. Design, Simulate and Analyze basic communication system using MATLAB.
6. Implement and analyze various diversity techniques using MATLAB to improve the SNR.
7. Design and Simulate OFDM system using MATLAB to generate high data rate communication with a sensitivity to sustainability.
8. Design and Simulate MIMO Communication system for 5G Communication System with a sensitivity to sustainability.

**Assessment Scheme:**

| **Prerequisites** | | Analog & Digital Communication |
|---|---|---|
| **Credits** | | 3 |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | 5 |
| 2 | Assignment | 10 |
| 3 | Class Participation | 5 |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I | 15 |
| 6 | Theory Exam-II | NA |
| 7 | Theory Exam-III | 25 |
| 8 | Report-I | NA |
| 9 | Report-II | NA |
| 10 | Report-III | NA |
| 11 | Project-I (Simulation) | 15 |
| 12 | Project-II (Simulation) | 15 |

| | | |
|---|---|---|
| 13 | Project-III | NA |
| 14 | Lab Evaluation-I | NA |
| 15 | Lab Evaluation-II | NA |
| 16 | Course Portfolio | NA |
| | **Total (100)** | 100 |

**Syllabus (Theory):**

**UNIT I History of Wireless Communication & Cellular Concepts**

History of wireless communication system, Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment-hand off- interference & system capacity, Coverage and capacity improvement.

**UNIT II Wireless Channels**

Large scale path loss – Path loss models: Free Space and Two-Ray models – Small scale fading- Parameters of mobile multipath channels – Time dispersion Parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

**UNIT III Digital Signaling for Fading Channels**

Structure of a wireless communication link, Principles of BPSK, Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle

**UNIT IV Multipath Mitigation Techniques**

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques.

**UNIT V Multiple Antenna Techniques**

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels

**References:**


1. Rappaport, Theodore S. Wireless communications: principles and practice. Vol. 2. New Jersey: prentice hall PTR, 1996.
2. Goldsmith, Andrea. Wireless communications. Cambridge university press, 2005.
3. Molisch, Andreas F. Wireless communications. Vol. 34. John Wiley & Sons, 2012.
4. Stüber, Gordon L. Principles of mobile communication. Vol. 2. Norwell, Mass, USA: Kluwer Academic, 1996.
5. Tse, David, and Pramod Viswanath. Fundamentals of wireless communication. Cambridge university press, 2005.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| **ECE509** | **Microwave Engineering** | 3 | 0 | 2 | 0 | 3 |

**Course Objectives:** This course aims to provide knowledge of microwave transmission, waveguides, generators and amplifiers and connectors. It will help students to understand the applications of microwave devices and know the precautions while using these high frequency gadgets.

**Learning Outcomes:**

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

1. Discuss the ITU standard for use of frequencies.
2. Explain the advantages of microwave frequencies and identify the frequency band used for particular device.
3. Explain the working principle of transmission lines and measure reflection coefficient, standing wave ratio and cutoff frequency.
4. Apply Smith Chart for Impedance matching of various loads with transmission line(s).
5. Analyze operation modes and parameters of various waveguides.
6. Use Scattering matrix for determining properties of passive microwave devices.
7. Analyze the I-V characteristics of Gunn Diode Oscillator.
8. Describe microwave radiation standards and safety precautions for Microwave devices.
9. Explain the possible health hazards of microwave radiation and also preventive mechanism.

**Assessment Scheme:**

| | | |
|---|---|---|
| **Prerequisites** | | **Digital Communication** |
| **Teaching Scheme (Hours per Week)** | | L T P 3 0 2 |
| **Credits** | | 3 |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | 5 |
| 2 | Assignment | 10 |
| 3 | Class Participation | 5 |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I | 15 |
| 6 | Theory Exam-II | NA |
| 7 | Theory Exam-III | 25 |

| | | |
|---|---|---|
| 8 | Report-I | NA |
| 9 | Report-II | NA |
| 10 | Report-III | NA |
| 11 | Project-I | NA |
| 12 | Project-II | NA |
| 13 | Project-III | NA |
| 14 | Lab Evaluation-I | 15 |
| 15 | Lab Evaluation-II | 15 |
| 16 | Course Portfolio | NA |
| | **Total (100)** | 100 |

**Course Syllabi (Theory):**

**Transmission structures and Resonators:** RF and microwave spectrum, historical background, application of RF and microwave. Transmission Line equation, Characteristic impedance, losses in transmission line, reflection coefficient, standing wave ratio, Smith Chart, Impedance matching, Rectangular Waveguides – TE/TM mode analysis, Characteristic Equation and Cut-off Frequencies, Circular Waveguides- Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes. Cavity Resonators– Introduction, Transmission cavity, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients.

**Microwave network theory and passive devices:** Scattering matrix -Concept of N port scattering matrix Representation-Properties of S matrix- S matrix formulation of two-port junction. Power divider, Microwave junctions -Tee junctions -Magic Tee - Rat race – Corners - bends and twists - Directional couplers -two-hole directional couplers- Ferrites - important microwave properties and applications– Termination - Gyrator- Isolator-Circulator - Attenuator

**Microwave Generators:** Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT, Magnetrons.

**Microwave semiconductor devices:** operation -Principles of tunnel diodes Transferred Electron Devices -Gunn diode- Avalanche Transit time devices- IMPATT and TRAPATT devices, MASER.

**Applications of microwave:** Radar systems, Satellite Communication System, Industrial Applications

**Course Syllabi (Practical):**

1. To study the basic components of Microwave Lab
2. To examine the frequency characteristics using direct reading frequency meter.
3. To calculate the frequency characteristics using formula.

4. To become familiar with the basic technique for measuring voltage standing wave ratio.
5. To study the attenuation characteristics of a variable attenuator.
6. To study I-V characteristics of Gunn Diode.
7. To measure coupling factor, directivity and insertion loss of a directional coupler.
8. To obtain the radiation pattern of a Horn Antenna.
9. To measure the gain of Horn Antenna.
10. To determine impedance of unknown load by measuring VSWR and the position of first field minimum.

**References:**


1. Pozar, David M. Microwave engineering. John Wiley & Sons, 2009.
2. Liao, Samuel Y. Microwave Devices and Circuits: For Anna University, 3/e. Pearson Education India, 1990.
3. Das, Annapurna, and K. Sisir. "Das, 2001." Microwave Engineering.
4. Collin, Robert E. Foundations for microwave engineering. John Wiley & Sons, 2007.
5. Kennedy, George, and Bernard Davis. Electronic communication systems. Vol. 20. Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1985.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ECE757 | Advanced Microcontrollers | 3 | 1 | 2 | 1 | 3 |

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

**Syllabus (Theory):**

**Background of ARM Architecture**, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture.
**Cortex-M3 Basics**: Registers, General Purpose Registers, StackPointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Cortex-M3Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.
**CORTEX EXCEPTION HANDLING AND INTERRUPTS Exceptions**: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency.
**CORTEX-M3/M4 PROGRAMMING** Cortex-M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.
**CORTEX-M3/M4 DEVELOPMENT AND DEBUGGING TOOLS**
STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development & Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyser.

**Text books:**

1. Programming ARM CORTEX-M4 TMC 123G with C by Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi and Sepehr Naimi.
2. Steve Furber, “ARM System-on-Chip Architecture”, 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403, 2015

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| ECE521 | Information Theory and Coding | 3 | 0 | 2 | 4 |

**Syllabus (Theory):**

Introduction to Information Theory Society ( itsoc) and its standards.
Definition of Information Measure and Entropy, Extension of an Information Source and Markov Source, Properties of Joint and Conditional Information Measures and A Markov Source, Asymptotic Properties of Entropy and Problem Solving in Entropy, Block Code and its Properties, Instantaneous Code and Its Properties, Kraft-McMillan Equality and Compact Codes
Shannon's First Theorem, Coding Strategies and Introduction to Huffman Coding, Huffman Coding and Proof of Its Optimality, Competitive Optimality of the Shannon Code,
Non-Binary Huffman Code and Other Codes, Adaptive Huffman Coding
Shannon-Fanon-Elias Coding and Introduction to Arithmetic Coding, Arithmetic Coding, 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, Discussion On 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, Introduction to Rate-Distortion Theory, Definition and Properties of Rate-Distortion Functions, Calculation of Rate-Distortion Functions, Computational Approach for Calculation of Rate-Distortion Functions
Use of coding techniques to design the ethical and efficient system for Society.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **S** | **Credits** |
| EE1208 | Digital Communication Networks | **3** | **0** | **2** | **0** | **4** |

**Course Objectives:** The course introduces the evolution of various digital communication networks. The course emphasizes on the architecture & protocols describing the wireless LANs, mobile cellular networks & optical networks. Components, applications, research issues & network management functions are discussed.

**Learning Outcomes:**

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

1. Analyze the OSI model of networks.

2. Analyze the various architectures employed in digital communication networks.

3. Analyze the different protocols used in the digital networks.

4. Design issues & protocols of wireless LANs. Emphasis on IEEE 802.11 standards. WiMax mobility support & broadband applications.

5. To formulate, solve & understand research issues in wireless networks

6. To design ad-hoc networks, sensor networks & mesh networks

7. Analyze satellite, optical and mobile cellular network architectures & protocols and their applications

8. Implement quality of service & network management functions

**Assessment Scheme:**

| **Evaluation Component** | **Marks** | **Modified plan (due to COVID 2019)** |
|---|---|---|
| Attendance | Nil | 2 |
| Assignment | 10 | 25 |
| Class Participation | 05 | 3 |
| Quiz | 10 | 10 |
| Theory Exam-I | 20 | 10 |
| Theory Exam-II | Nil | 0 |
| Theory Exam-III | 20 | 20 |
| Report I | 5 | 5 |
| Report II | Nil | Nil |
| Report III | Nil | Nil |
| Project I | 10 | 5 |
| Project II | Nil | Nil |
| Project III | Nil | Nil |
| Lab Evaluation I | Nil | 10 |
| Lab Evaluation II | 20 | 10 |
| Course Portfolio | Nil | Nil |
| **Total (100)** | **100** | **100** |
| **Evaluation Scheme for Re-Test:** | | |
| **Theory Exam - III** | 20 | 20 |
| **Lab Evaluation - II** | 20 | 20 |

| | |
|---|---|
| | |

| | | | | |
|---|---|---|---|---|
| | **Total (40)** | **40** | **40** | |

**Syllabus (Theory):**

1. Evolution of Communication Networks, Layered Architecture and OSI Model, Unified View of Protocols and Services
2. Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications. WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications.
3. Cellular networks, Satellite Network, Applications. Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.
4. Optical networks Client layers of the optical layer, SONET/SDH, Multiplexing, layers, Frame Structure, ATM functions, Adaptation layers, Quality of service and flow, ESCON, HIPPI, Network management functions.

**Syllabus (LABORATORY):**

1. NS2 Implementation of congestion control protocol (TCP over IP) after creating a duplex link using nodes in a network
2. Analyse performance of IEEE 802.4 token bus LAN protocol in MAC layer
3. Analyse performance of IEEE 802.5 token ring LAN protocol in MAC layer
4. Implement ARQ stop and wait protocol/sliding window protocol in Data Link layer of OSI model by creating a NS2 network scenario
5. Implement the different frames of HDLC protocol by creating a NS2 network scenario
6. Execute the Distance Vector Routing and Link State Algorithms
7. Analyse the performance of IEEE 802.3 CSMA/CD LAN protocol operating at MAC layer
8. Execute the go back N protocol/ selective repeat transmission flow control protocol
9. Design and Analyze a wireless sensor network architecture (also with TCP) using NS2
10. Design and Analyze a mobile ad-hoc network architecture using NS2

**Text books:**

1. “Optical Network Design and Planning”, Simmons, Jane M, Springer.
2. “Computer Networks”, Andrew S. Tanenbaum, David J. Wetherall, Pearson, 2013.
3. Tse, David, and Pramod Viswanath. Fundamentals of wireless communication. Cambridge university press, 2005.

**Reference Books**:

1. Data and Computer Communications, William Stallings, 8/e
2. Data Communication and Networking, Behrouz Forouzan, 5/e

**Web Resources:**

http://nptel.ac.in/course

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

**Course Objective:**

The main objective of the course is: -

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

**Learning Outcomes:**

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

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

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

| | | |
|---|---|---|
| | **Total (30)** | **30** |

**UNIT-I Energy Sources and Sustainability (10 Hours)**
Energy chain and common forms of usable energy - Present energy scenario - World energy status - Energy scenario in India - Introduction to renewable energy resources – Sustainability, Triple bottom line, sustainable smart city.

**UNIT-II Biomass Energy (10 Hours)**
Biomass as energy resources; Bio energy potential and challenges-Classification and estimation of biomass; Source and characteristics of biofuels: Biodiesel, Bioethanol, Bio petrol, Biogas; Types of biomass energy conversion technologies; waste to energy conversions; Biomass resource development in India; Future of Biomass energy in India & Global Scene; Environmental benefits.

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

**UNIT-IV Hydro Power Energy (10 Hours)**
Hydro power energy, types of hydropower plants and schemes, runoff studies, assessment of hydropower potential of a basin, storage and pondage, load studies, elements of hydropower plants, types of power houses, low head turbines.

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

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

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE1203 | **Optical Fiber Communication** | 3 | 0 | 2 | 4 |

**Syllabus (Theory):**

Basic laws of Electromagnetics, Optical fiber modes, Step index and graded index fibers, Fiber materials, fiber fabrication, Fiber optic cables. Attenuation, signal distortion in optical fibers, Dispersion-intra modal & inter modal, Dispersion shifted and flattened fiber.

Optical Sources- LED's- Structure, Materials, Characteristics, Modulation, Power & efficiency, Laser Diodes - Basic concepts, Hetero Structure, properties and modulation.

Optical Detectors - PIN and Avalanche photo diodes, photo detector noise, detector response time, Avalanche multiplication noise. Photo diode materials. Fundamental of Optical Receiver Operation.

Optical Fiber Communication Systems- Analog and digital optical communications, Direct detection receivers, Coherent detection, Noises, Comparison of direct and coherent detection, DSP algorithms for coherent optical communications Multiplexing techniques in fiber-optic communications

Optical Fiber Measurements- Standards for measurements IEC 60793-for Optical fibres –Fiber proof test., Attenuation, Bandwidth, Chromatic dispersion, Numerical aperture, Macro bending loss Measurements of Fiber attenuation, Dispersion, refractive index profile.

**Text Book(s):**


1. Keiser Gerd, "Optical Fiber Communications", Tata McGraw-Hill, Fourth edition 2008.
2. John M. Senior, "Optical Fiber Communication: Principle and Practice", Pearson.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="4">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Credits</th></tr>
<tr><td>EE1204</td><td>Antenna Design</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>

**Syllabus (Theory):**

Standard Test Procedures for Antennas

Unit 1: Understanding the basics of Antenna Design parameters, standards and IEEE 149-1977 test procedure, Antenna Introduction, Antenna Fundamentals, Antenna Radiation Hazards, Dipole Antennas, Introduction to AISG (The Antenna Interface Standards Group).

Unit 2: Monopole Antennas, Loop Antennas, Slot Antennas, Linear Arrays, Planar Arrays

Unit 3: Microstrip Antennas (MSA), Rectangular MSA, MSA Parametric Analysis-I, Circular MSA

Unit 4: Broadband MSA, Compact MSA, Tunable MSA, Circularly Polarized MSA, MSA Arrays,

Unit 5: Helical Antennas, Horn Antennas, Yagi-Uda and Log-Periodic Antennas, Reflector Antennas, Design of low power Antenna having less EM radiation for proper transmission. Design the basic projects using AISG (The Antenna Interface Standards Group) for sustainable development of Human and society.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE733 | Advanced Control Systems | 3 | 0 | 2 | 4 |

**Syllabus (Theory):**

UNIT1: CLASSICAL CONTROL THEORY AND PRACTICE. LIMITATIONS
Control problem formulation. Discrete time control systems. Introduction to system identification. PID and compensators design. Performance assessment. Limits of performance. Technical issues. Standards: IEC 61131 – Industrial controllers. ISA 88 – Batch Control Systems. ISA 106 – Procedural Automation.

UNIT2: STATE SPACE ANALYSIS
Basic concepts. Linear algebra. State vector, state model, state model of linear systems, state model for Single-Input/Single-Output linear systems and linearization of the state equation. Canonical representations, transfer function for state model. Properties of the state transition matrix. Computation of state transition matrix. Controllability and observability.

UNIT3: STATE FEEDBACK AND OBSERVERS
Full-state feedback control design. Observer design. Integrated full-state feedback and observer. Reference Inputs. Introduction to optimal control problems.

UNIT4: CASE STUDIES
Application of advanced control systems theory to sustainability problems: health, energy, water, smart cities, etc.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE1207 | **Circuit Analysis and Design** | 3 | 0 | 2 | 4 |

**Syllabus:**

**UNIT-I**

**Network** Concepts: RLC parameter, Independent and dependent sources, Voltage/current relationship for individual element, source transformation techniques, KCL, KVL for network having both Independent and dependent sources star-delta transformation, IEC 60050 standards.

**Network Analysis Techniques and theorems:** Superposition, Thevenin and Norton Theorem, Maximum power transfer, Reciprocity theorem, Series and parallel resonant circuits, Mutual inductance, Dot Convention, magnetically couples circuit analysis.

**UNIT-II**

**AC AND DC Transients Analysis:** Laplace transform fundamentals, properties and theorems, unit step function, other unit function, the impulse, ramp and doublet, Laplace transform for shift and singular, functions, initial and final value theorems, Formulation and solution of network equilibrium equations on loop and node basis, Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Time Constant, Complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations.

**UNIT-III**

**Two Port Network:** Voltage & current ratio of two port network, Admittance, impedance, hybrid and transmission parameter of two port networks, Conversion of one parameter to another parameter, Series, parallel and cascade connection of two port networks, Condition of reciprocity & symmetry, Iterative and Image Impedance.

**Filter Circuits Design:** Constant k type low pass, high pass, band pass and band elimination passive filters, 1801-2015 - IEEE Standard

**UNIT-IV**

**Network Functions:** Concepts of Complex Frequency, Transform Impedance, Network functions of one and two port network, concepts of poles and zeros, properties of driving point and transfer functions, time response stability from pole zero plot, Hurwitz Polynomials.

**Syllabus (Practical):**

1. Study and verification of Thevenin's Theorem.

2. Study and verification of Norton Theorem.
3. Study and verification of Superposition theorem.
4. Study and verification of Maximum power transfer Theorem.
5. Transient analysis of RL/RC circuits.
6. Transient analysis of series RLC circuits.
7. Transient analysis of parallel series RLC circuits.
8. Design Low pass filter.
9. Design high pass filter.
10. Design band pass filter.

**Text Book(s):**


1. K. M. Soni, "Circuit & Systems" S. K. Kataria & Son, Eight Edition, 2008.
2. Van Valkenburg M.E., "Network Analysis", Prentice Hall, India, 3rd Edition, 2002.
3. A. Chakarbrati, "Circuit Theory", Dhanapat Rai and Co.


**Reference Book(s):**


1. T.K. Nagsarkar, M.S. Sukhija," Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.
2. Roy Choudhary, "Network Theory", TMH, 3rd Edition, 2004
3. Edminister Joseph A., "Electrical Circuits, Schaum's Outline Series", Tata McGraw Hill, 2nd edition, 1983.
4. Hayt W.H., Kemmerly J. E., Durbin S. M., "Engineering Circuit Analysis", Tata McGraw Hill, 6th edition, 2006

**Course Syllabus: B. Tech EE (Batch 2016-20)**

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE301 | Network Theory-I | 3 | 0 | 2 | 0 | 4 |

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

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

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

## Syllabus (Theory):

**UNIT I - NETWORK THEOREMS**: Sources, Voltage/current relationship for individual element, Kirchhoff's laws and applications, Superposition theorem, Thevenin's theorem, Norton Theorem, Maximum power transfer theorem, Reciprocity theorem, Tellegen's Theorem.

**UNIT II - GRAPH THEORY:** Fundamental concepts, definitions of a graph and various related terms, paths and circuit connections, trees of a graph, cut sets and tie sets, non-separable planner and dual graphs, matrices of oriented graphs, properties and inter relationships of incidence, tie and cut set matrices, complete circuit analysis using tie set and cutest matrices.

**UNIT III Polyphase Circuits:** Introduction, 3-phase emf generation, V-I relationship in star and delta networks, Power factor, measurement of power in 3-phase circuits, Series and parallel resonance in single phase ac circuits, dual networks.

**UNIT IV - TRANSIENTS ANALYSIS:** Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Initial and final value theorem, Time Constant, Complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations.

**UNIT V - Fourier Analysis:** Introduction, exponential form of fourier series, trigonometric form of fourier series, symmetry in fourier series, frequency spectrum, average/rms value of a periodic complex wave, expression of power with non-sinusoidal voltage and current, shifting of function, comparison between laplace and fourier transform.

## Syllabus (Practical):

1. Study and verification of Thevenin's Theorem.

2. Study and verification of Norton Theorem.
3. Study and verification of Superposition theorem.
4. Study and verification of Maximum power transfer Theorem.
5. Transient analysis of (i) RL (ii) RC circuits.
6. Transient analysis of RLC series circuits.
7. Measurement of active power and reactive power using two and three wattmeter method.
8. Time response of first order system using various test signals (MATLAB).
9. Simulation of RLC circuits in series and parallel configuration for the study of resonance (MATLAB).
10. Time response of second order system using various test signals (MATLAB).

**Textbook(s):**


1. Van Valkenburg M.E., "Network Analysis", Prentice Hall, India, 3rd Edition, 2002.
2. A. Chakarbrati, "Circuit Theory", Dhanapat Rai and Co.
3. K.M.Soni, "Circuit & Systems" S.K.Kataria& Son, Eight Edition, 2008.


**Reference Book(s):**


1. T.K.Nagsarkar,M.S. Sukhija,"Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.
2. Roy Choudhary, "Network Theory", TMH, 3rd Edition, 2004.
3. Edminister Joseph A., "Electrical Circuits, Schaum's Outline Series", Tata McGraw Hill, 3rd edition, 2012.
4. Hayt W.H., Kemmerly J. E., Durbin S. M., "Engineering Circuit Analysis", Tata Mcgraw Hill, 6th edition, 2006.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE302 | Electrical Machines-I | 3 | 1 | 2 | 0 | 5 |

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

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

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

## Syllabus (Theory):

**UNIT-I ELECTROMECHANICAL ENERGY CONVERSION:** Introduction, Flow of Energy, Energy in Magnetic Systems, Singly Excited System, Determination of Mechanical Force, Torque Equation, Doubly Excited System, energy stored in magnetic field, Electromagnetic Torque, Generated EMF in Machines.

**UNIT-II SINGLE PHASE TRANSFORMER**: Working principle, Construction, EMF equation, Equivalent circuit and phasor diagram, Voltage regulation, losses and Efficiency, All Day Efficiency, O.C./S.C. Test, Sumpner Test, Polarity Test, Parallel Operation.

**AUTO TRANSFORMER:** Single phase and Three Phase Autotransformer, Efficiency, advantages and disadvantages over two winding transformer, applications of auto transformer.

**UNIT III THREE PHASE TRANSFORMER:** Construction, Connections and phasor groups, Parallel Operation and load sharing, magnetizing Inrush, harmonics in transformer, Three Winding Transformer.

**UNIT IV DC GENERATOR:** Construction, Armature Winding, EMF Equation, Armature reaction, Commutation, Methods for Improving Commutation, Performance characteristics of dc generators, Parallel operation.

**UNIT V DC MOTOR:** Construction, Operation of a DC Motor, Starting of DC motors, Speed Regulation, Losses in a DC Motors, Methods of Speed Control, Performance characteristics of DC Motors Efficiency and Testing of dc Machines.

## Syllabus (Practical):

1. Speed control of D.C. shunt motor by (a) Field current control method & plot the curve for speed vs. field current. (b) Armature voltage control method & plot the curve for speed vs armature voltage.
2. Speed control of a D.C. Motor by Ward Leonard method and to plot the curve for speed vs applied armature voltage.
3. To determine the efficiency of D.C. Shunt motor by loss summation (Swinburne's) method.
4. To determine the efficiency of two identical D.C. Machine by Hopkinson's regenerative test.
5. To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.
6. To perform back-to-back test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit.
7. To perform parallel operation of two 1-phase transformers and determine their load sharing.
8. To determine the efficiency and voltage regulation of a single-phase transformer by direct loading.
9. To study the performance of 3-phase transformer for its various connections, i.e. star/star star/delta delta/star and delta/delta and find the magnitude of 3rd harmonic current.
10. To perform parallel operation of two 3-phase transformers and determine their load sharing.

**Textbook(s):**


1. Nagrath I.J. and Kothari D.P, "Basic Electrical Engineering" TMH, Third Edition 2011.
2. Electric Machinery and Transformers-Bhag S. Guru, Huseyin R. Hiziroglu-Oxford Publication.
3. P S Bhimbra, "Electrical Machines" Khanna Publishers.
4. J B Gupta, "Theory and Performance of Electrical Machines"4th Edition, S.K. Kataria and Sons


**Reference Book(s):**


1. Electrical Engineering - Principles and Applications, Allan R. Hambley, PHI, fourth edition-2007.
2. A. E. Fitzerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery" 6th Edition, Tata McgrawHill.
3. Ashfaq Hussain, "Electrical Machines" Dhanpatrai and Sons.
4. B. L. Theraja, "A Text Book on Electrical Technology" S.Chand, VolumeII. 2012.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE303 | Measurement & Instrumentation | 3 | 0 | 2 | 0 | 4 |

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

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

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

**Course Syllabi (Theory):**

**UNIT I Introduction of Measurements and Theory of Error:** Functional elements of an instrument, Static and dynamic characteristics, Errors in measurement, Statistical evaluation of measurement data – Standards and calibration. Analog Measurement of Electrical Quantities: PMMC, MI, Electro dynamic, Thermal, Electrostatic & Rectifier type instruments, Electro dynamic Wattmeter, errors & remedies in wattmeter and Energy meter. Instrument Transformers.

**UNIT II Digital Measurement of Electrical Quantities:** Concept of digital measurement, block diagram Study of digital voltmeter, A/D and D/A converters, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.

**Resistance Measurement:** Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Earth Resistance.

**UNIT III AC Bridges:** Sources and detectors, Generalized treatment of four-arm AC bridges, Maxwell's bridge, Hay's bridge and Anderson bridge, De-Sauty Bridge and Wien's bridge. Sources of error in bridges and precautions.

**UNIT IV POTENTIOMETER:** Construction, Theory and Principle of operation of DC Potentiometers and AC Potentiometers, Calibration of Ammeter, Voltmeter and wattmeter, Volt-ratio box.

**UNIT V Transducers:** Definition, Classification, Selection Criteria, Principle, Strain Gauge, Thermistor, RTD, Piezoelectric, Thermocouple, LVDT, Application of transducers.

**Course Syllabi (Practical):**

1. Measurement of resistance by kelvin's double bridge.
2. To study Anderson Bridge.
3. To Study Wien's Bridge.
4. To study Maxwell's Capacitance & Inductance Bridge.
5. To study Solar Energy Trainer with built in Voltmeter & Ammeter.
6. To study Ultrasonic transducer Trainer
7. Displacement measurement using LVDT
8. Temperature measurement using RTD, Thermocouple.
9. Calibration of single-phase energy meter using phantom loading.
10. Calibration of ammeter/voltmeter using potentiometer.
11. Measurement of earth resistance by fall of potential method.

**Textbooks:**

1. Cooper & Helfrick, "Modern Electronic Instrumentation and Measurement Techniques", PHI.
2. A.K. Sawhney, "A Course in Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons

**Reference Books:**

1. H. S. Kalsi, "Electronic Instrumentation", TMH.
2. Thomas and Clark, "Handbook of Electronic Instruments and Measurement Techniques", PHI.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE401 | Electrical Machine-II | 3 | 0 | 2 | 0 | 4 |

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

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

**Syllabus (Theory):**

**UNIT-I THREE PHASE INDUCTION MOTOR:** Basic theory and construction of squirrel-cage and wound-rotor motors; equivalent circuit; measurement of equivalent circuit parameters, speed and slip, starting & running torque, speed/torque curves, effect of change in voltage & frequency on torque, no load & block rotor test, circle diagram,. Starting and speed control methods, cascaded connection, Braking, Effect of rotor resistance. Cogging, Crawling. Double cage squirrel cage induction motor, Induction generator, Induction regulator.
**UNIT-II SINGLE-PHASE INDUCTION MOTOR:** Double revolving field theory, equivalent circuit, no load & block rotor tests, starting methods. Classification of 1-phase induction motors with applications.
**UNIT-III ALTERNATOR:** Basic concepts, types and construction, generated emf, distribution &Pitch factor, armature reaction, phasor diagram, synchronous reactance, equivalent circuit, open and short-circuit characteristics, voltage regulation, synchronization, parallel operation of generators.
**UNIT-IV SYNCHRONOUS MOTORS:** Working principle and construction, phasor diagrams, speed torque characteristics, V-curves, starting methods, performance calculations, applications, synchronous condenser, hunting.
**UNIT-V Special machines:** Linear induction motor, switched reluctance motor, stepping motors, permanent magnet brushless DC motor, permanent magnet synchronous motor.

**Syllabus (Practical):**

1. To perform OC & SC test on a three-phase transformer & find its efficiency and parameters for its equivalent circuit.

2. To perform sumpner's back-to-back test on 3 phase transformers, find its efficiency & Parameters for its equivalent circuits.
3. Seperation of iron losses of Single- phase transformer.
4. To perform no load and blocked rotor test on a 3-phase induction motor and to determine the parameters of its equivalent circuits. Draw the circle diagram and compute the following (a) Max. Torque (b) Current (c) slip (d) p.f. (f) Efficiency.
5. To perform the load test on a 3-phase induction motor and determine its performance characteristics (a) Speed vs load curve (b) p.f. vs load curve (c) Efficiency vs load curve (d) Speed vs torque curve.
6. To plot OCC & SCC of an Alternator and to determine its regulation by synchronous impedance method.
7. To find Xd and Xq of a salient pole synchronous machine by slip test.
8. To plot the V-curve for a synchronous motor at 100 % Load, 75 % Load, 50 % Load and at No-Load.

**Textbook(s):**


1. Nagrath I.J. and Kothari D.P, "Basic Electrical Engineering" TMH, Third Edition 2011.
2. Electric Machinery and Transformers-Bhag S. Guru, Huseyin R. Hiziroglu-Oxford Publication.
3. P S Bhimbra, "Electrical Machines" Khanna Publishers.
4. J B Gupta, "Theory and Performance of Electrical Machines"4th Edition, S.K. Kataria and Sons.


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3. Ashfaq Hussain, "Electrical Machines" Dhanpatrai and Sons.
4. B. L. Theraja, "A Text Book on Electrical Technology" S.Chand, VolumeII. 2012.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE402 | Network Theory-II | 3 | 0 | 0 | 0 | 3 |

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

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

**Syllabus (Theory):**

**UNIT-I NETWORK FUNCTIONS:** Concepts of Complex Frequency, Transform Impedance, Network functions of one and two port network, concepts of poles and zeros, properties of driving point and transfer functions, time response stability from pole zero plot.
**UNIT-II NETWORK SYNTHESIS:** Network reliability, Hurwitz Polynomials, Positive real functions, Properties of RC, RL & LC networks, Foster and Cauer forms of RC, RL & LC networks.
**UNIT-III TWO PORT NETWORK:** Basics of two port networks, Admittance, impedance, hybrid and transmission parameter of two port networks, Conversion of one parameter to another parameter, Series, parallel and cascade connection of two port networks, Condition of reciprocity & symmetry, Iterative and Image Impedance.
**UNIT-IV FILTER CIRCUITS:** Types of passive filters, Low-pass filter, High-pass, Band-pass, Band-reject filters, Advantages of active filters over passive filters.
**UNIT-V COUPLED CIRCUITS:** Self-inductance, coupled inductor, Mutual inductance, Mutual inductance between two coupled inductors, Dot convention, Determination of coefficient of coupling from energy calculations in coupled circuits, Inductive coupling, Tuned Coupled circuits.

**Textbook(s):**


1. Van Valkenburg M.E., “Network Analysis”, Prentice Hall, India, 3rd Edition, 2002.
2. Chakarbrati, “Circuit Theory”, Dhanapat Rai and Co.
3. K.M. Soni, “Circuit & Systems” S.K. Kataria & Son, Eight Edition, 2008.

**Reference Book(s):**


1. T.K.Nagsarkar,M.S. Sukhija,"Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.
2. Roy Choudhary, "Network Theory", TMH, 3rd Edition, 2004.
3. Edminister Joseph A., "Electrical Circuits, Schaum's Outline Series", Tata McGraw Hill, 3rd edition, 2012.
4. Hayt W.H., Kemmerly J. E., Durbin S. M., "Engineering Circuit Analysis", Tata Mcgraw Hill, 6th edition, 2006.

<table>
<tr><th colspan="4" rowspan="2">Course code</th><th colspan="3" rowspan="2">Course Title</th><th colspan="5">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td colspan="4">EE403</td><td colspan="3">Energy Sources</td><td>3</td><td>1</td><td>2</td><td>0</td><td>5</td></tr>
<tr><th colspan="6">Evaluation Scheme (Theory)</th><th colspan="6">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test – I</th><th>Mid Term Test – II</th><th>End Term Test</th><th colspan="2">Class Participation/ Additional Continuous Evaluation</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th colspan="3">Class Participation/ Additional Continuous Evaluation</th><th>Total Marks</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td colspan="2">10</td><td>100</td><td>20</td><td>50</td><td colspan="3">30</td><td>100</td></tr>
</table>

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

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

**Syllabus (Theory):**

**UNIT I TARIFFS & SELECTION OF POWER PLANTS**: Tariff and types of tariffs, comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant, Selection and location of power plants.

**UNIT II POWER PLANTS: HYDRO POWER PLANT:** Ecological aspects, Choice of site, Hydrology, Mass curve, flow duration curve, water storage, classification of hydroelectric plants, pumped storage plants, operating cost. **THERMAL POWER PLANT:** Choice of site, arrangement of plant and principal auxiliaries, main electrical equipments, instrumentation, speed governor, operating cost.

**NUCLEAR POWER PLANT:** Nuclear Physics, moderator materials, Fission & Fusion reactions, types of reactors, main components of nuclear power plant, operation and control of reactors, choice of site, Comparison of various Power Plants.

**UNIT III POWER PLANT ECONOMICS:** Economic Aspects of Power Plant Operation, methods of depreciation, effect of load factor, demand and diversity factors, power factor improvement.

**UNIT IV NON-CONVENTIONAL ENERGY SOURCES-MAIN SOURCES:** Introduction, availability, classification, relative merits and demerits. **SOLAR ENERGY:** Theory of solar cells, solar cell array, solar power plant, limitations, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **WIND ENERGY:** Wind power, site selection and criterion, classification of rotors, wind characteristics, Performance and limitations of energy conversion systems.

**UNIT-V NON-CONVENTIONAL ENERGY SOURCES-OTHER SOURCES** Geothermal energy, Magneto-hydrodynamics (MHD, Fuel Cells, Biomass, Ocean thermal energy conversion, waves and tidal waves.

**Syllabus (Practical):**

1. Measure of solar irradiance Intensity.
2. Study of solar energy trainer and solar panel.
3. Calculation of power and load for solar voltaic system.
4. Study of solar battery charger with MPPT technique.
5. Study of wind training system.
6. Study of bio-energy training system.
7. Study of fuel cell trainer.
8. Modeling and simulation of hybrid energy system.
9. Modeling and simulation grid connected hybrid energy system.
10. Modeling and simulation solar PV module.

**Textbook(s):**

1. Generation of Electrical Energy –B.R. Gupta.
2. Non-Conventional Energy Sources-G.D. Rai-Khanna Publication.
3. Raja etal, "Introduction to Non-Conventional Energy Resources" SciTech Publications.
4. Power System Engineering – I. J. Nagrath & D. P. Kothari.

**Reference Book(s):**

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
3. D.S. Chauhan," Non-conventional Energy Resources" New Age International.
4. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>MA 404</td><td>Engineering Optimization</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
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<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="4">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test – I</td><td>Mid Term Test – II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks</td><td>Mid Term Test - I</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks</td></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td>30</td><td>100</td></tr>
</table>

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

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

**Syllabus (Theory):**

**Unit – I: Linear Programming Problems:** Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem.

**Unit – II: Non-Linear Programming Problems:** Introduction, Single variable and multi variable optimization, Maxima and Minima, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming.

**Unit – III: Project and Simulation:** Simulation, Project Management with CPM/PERT.

**Unit – IV: Optimization Models:** Basic structure of queuing models, role of the exponential distribution, The birth and death processes, queuing models based on birth and death processes (M/M/1 Model), , Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, Two jobs and m Machines Problems

**Unit-V: Optimization in Electrical Engineering:** Importance of Power System Optimization, Economic Operation of Electric Power Systems, Economic Dispatch, Unit Commitment, Hydrothermal Scheduling, Optimal Reactive Power Dispatch, Optimal Power Flow, Applications in Power Systems optimization.

**Syllabus (Practical):**

Problem solving using various software packages for the following areas.

1. Linear Programming
2. Non-linear Programming
3. Power System Optimization

4. Case Study

**Textbooks and Reference books:**


1. S S Rao, Engineering Optimization: Theory and Practices, New Age International, 1996.
2. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., (Indian Adapted Edition), 2005.
3. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2003.
4. Ronald L. Rardin, Optimization in Operations Research. Pearson Education, First Indian Reprint 2002.
5. Pant. J.C., Introduction to Optimization: Operations Research, Jain Brothers, 5th Ed., 2000.
6. Weerakorn Ongsakul, Dieu Ngoc Vo, “Artificial Intelligence in Power System Optimization” CRC Press, 2013.
7. Soliman Abdel-Hady Soliman, Abdel-Aal Hassan Mantawy, “Modern Optimization Techniques with Applications in Electric Power Systems” published by Springer 2012.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE501 | Linear Control Systems | 3 | 0 | 2 | 0 | 5 |

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

**Syllabus (Theory):**

**UNIT I INTRODUCTION TO CONTROL SYSTEMS:** Open loop and closed loop systems. Components. Case studies. Historical development. State of the art.

**UNIT II MATHEMATICAL MODELING OF PHYSICAL SYSTEMS:** Modeling of physical systems such as mechanical, electrical, thermal and chemical systems, analogous systems, concept of transfer function, poles, zeros, order and type of the system, computation of overall transfer function, block diagram reduction techniques, signal flow graphs.

**UNIT III TIME RESPONSE ANALYSIS:** Standard test signals, transient and steady state response of first and second order systems, time response specifications, types of systems, steady state error and error constants. Basic control action and automatic controllers, Effect of PI, PD and PID controllers on system performance.

**UNIT IV STABILITY ANALYSIS OF CONTROL SYSTEMS:** Notations of stability, Necessary conditions for stability, Routh-Hurwitz stability criterion, Relative stability, Basic properties of root locus, rules to construct root locus, stability analysis using root locus.

**UNIT V FREQUENCY DOMAIN ANALYSIS:** Introduction to frequency response, frequency domain specifications, stability analysis using Bode plots, stability analysis using Polar and Nyquist plots.

**Syllabus (Practical):**

1. Introduction to MATLAB Computing Control Software.
2. Defining Systems in TF, ZPK form, and (a) Plot step response of a given TF and system in state-space. Take different values of damping ratio and $w_n$natural undamped frequency (b) Plot ramp response.
3. To design 1st order R-C circuits and observes its response with the following inputs and traces the curve.
    - Step

- Ramp
- Impulse

4. To design 2$^{nd}$ order electrical network and study its transient response for step input and following cases.
   (a) Under damped system
   (b) Over damped System.
   (c) Critically damped system
5. To Study the frequency response of following compensating Networks, plot the graph and final out corner frequencies.
   (a) Leg compensation Network
   (b) Lead compensation Network
   (c) Leg-lead compensation Network.
6. To study the Potentiometer error detector.
7. To draw characteristics of a.c servomotor.
8. To Study the bode plot for a 2$^{nd}$ order system and find GM and PM.
9. To study and design PID controllers.
10. To study and draw the characteristics of stepper motor.

**Text Book(s):**


1. I J Nagrath and M Gopal: Control Systems Engineering, 3rd Ed, New Age Publication.
2. B C Kuo: Modern Control Engineering, , New Age Publication.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Pvt. Ltd., New Delhi.


**Reference Book(s):**


1. Robert H Bishop: Modern Control Systems, Boyd and Fraser pub
2. Norman S.Nise, "Control System Engineering", John Wiley & Sons.
3. Gene F. Frankline, J. David Powell, Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", Pearson Education Inc., 2006

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE503 | Transmission & Distribution of Electrical Power | 3 | 1 | 0 | 0 | 4 |

| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mid Term Test – I | Mid Term Test –II | End Term Test | Class Participation/ Additional Continuous Evaluation | Total Marks | Mid Term Test - I | End Term Test | Class Participation/ Additional Continuous Evaluation | | Total Marks |
| 15 | 15 | 40 | 30 | 100 | - | - | - | - | - |

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

**Syllabus (Theory):**

**UNIT I INTRODUCTION OF SUPPLY SYSTEM:** Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors, distributed and concentrated loads, interconnection HVDC and EHV AC transmission, Kelvin's law.

**UNIT II OVERHEAD TRANSMISSION LINE:** Types of conductors, Calculation of line parameters – Inductance and Capacitance of single phase, three phase, symmetrical and unsymmetrical configurations, Concepts of GMD and GMR, Transposition, Bundle conductors, Double or parallel circuit, Effect of earth on capacitance calculation, Interference with communication circuit, Concept of Corona discharge.

**UNIT III OVERHEAD LINE INSULATORS**: Different types, Insulator failure, voltage distribution in insulator string and grading, improvement of string efficiency.

**MECHANICAL DESIGN OF OVERHEAD LINES:** Sag and tension calculations, Effect of ice and wind, Stringing chart, Sag template, Tower design, Spacing and clearance, Vibration damper.

**UNIT IV PERFORMANCE OF LINES:** Short, medium and long lines - Representation, A, B, C, D constants, Voltage regulation and Transmission efficiency, Ferranti effect, Mathematical expressions, Effect of active and reactive power flow on bus voltage magnitude and phase angle.

**UNIT V UNDERGROUND CABLES:** Different types, insulating materials, Dielectric stress, Grading, Capacitance, Heating and causes of breakdown.

**POWER SYSTEM GROUNDING**: Equipment grounding, Neutral grounding – Different methods, Grounding transformer.

**Textbook(s):**


1. C. L. Wadhwa," Electrical Power System", New age international publisher.
2. S. Sivanagaraju," Electric Power Transmission and Distribution", Pearson Education.
3. B R Gupta: Power System Analysis & Design, S. Chand Publishers
4. Soni, Gupta, Bhatnagar, "Electrical Power System" Dhanpat Rai & Sons.


**Reference Book(s):**

1. William H. Kersting, “Distribution system modeling and analysis”, CRC press  publication.
2. Sivanagaraju and Satyanarayana, “Electrical Power Transmission and Distribution”, Pearson Education.
3. J.B. Gupta “Transmission & Distribution of Electrical Power”, S.K. Kataria& Sons publication.

**E-resource(s)**

4. NPTEL: http://nptel.ac.in/courses/108102047/ http://nptel.ac.in/courses/117101056/ http://nptel.ac.in/courses/117101057/
5. NCTEL: http://www.nitttrchd.ac.in/sitenew1/nctel/electrical.php

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| EE706 | Advances in Power Delivery | 3 | 1 | 0 | 0 | 5 |

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

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

**Syllabus (Theory):**

**UNIT I: DISTRIBUTION SYSTEMS & LOAD FORECASTING:** Distribution of power, future distribution systems, load forecasting, power factor improvement, system harmonics, monitoring and compensation in distribution system, earthing and grounding.

**UNIT II: DISTRIBUTION AUTOMATION**: Distribution System Topology and Structure, Distribution Automation (DA) and Control, Distribution Automation Function, Distribution Management Systems, Voltage/VAr Control, Reconfiguration of Distribution Systems, Intelligent Systems in Distribution Automation, Automatic Meter Reading, Communication Systems for Distribution Automation Systems, Utility Communication Architecture.

**UNIT III: EHV AC transmission:** Engineering Aspects of EHV AC Transmission System: Principles, configuration, special features of high voltage AC lines, power transfer ability, reactive power compensation, audible noise, corona bundle conductors, electric field, right of way, tower configuration, Principles of radio interference, origin of radio interference, method of propagation, factors to be considered in line design.

**UNIT IV: HVDC transmission:** HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission, Basic scheme and equipment of converter station, Ground return, Basic principles of DC link control and basic converter control characteristics, multi-terminal HVDC systems, HVDC circuit breaker, Application of HVDC transmission.

**UNIT V: FACTs:** Introduction to FACTS controllers, types of FACTS controllers, Brief description of STATCOM, Thyristor controlled series capacitors and unified power flow controller, Shunt capacitors and reactors, saturable reactors, Thyristorised static VAR compensators- TCR, FC-TCR and TSC- TCR.

**Textbooks:**

1. A S Pabla, "Electric Power Distribution", TMH

2. B R Gupta, “Power System Analysis & Design” S. Chand Publishers
3. Nagrath Kothari, “Modern Power System Analysis”, TMH
4. Rokosh Das Begamudre, “EHV AC. Transmission Engineering” Wiley Easter Ltd. New Delhi.
5. K. R. Padiyar,”HVDC Power Transmission Systems”, New Age International.

**Reference Books:**

1. J. J. Grainger & W. D. Stevenson, “Power System Analysis”, TMH.
2. Kamaraju, “Electrical Power Distribution Systems”, TMH
3. P. Kundur,” Power System Stability & Control”, TMH.
4. H.V.D.C. Transmission – P. Kundur, TMH.
5. James A. Momoh, “Electric Power Distribution, Automation, Protection and control” CRC press, 2007.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE601 | Power System Analysis | 3 | 1 | 2 | 4 |

**COURSE DESCRIPTION:**

The course lays the foundation for exploring the ways and means to perform power system analysis in normal operation and under symmetrical and unsymmetrical faults. Models of generators, transformers and transmission lines essential for such analyses are assembled. Additionally, principles for the formulation, solution, and application of load flow. Stability problems. Rotor dynamics and swing equation. Equal-area criterion of stability. Factors affecting transient stability.

**Learning Outcomes**

1. Analyse the power systems in steady state operation using impedance circuit model.
2. Analyse the power systems subject to symmetrical and unsymmetrical faults.
3. Identify, formulate and solve the stability problems.
4. Design the power system with sensitivity to possible environment impacts.
5. Analyse multi-node power systems using admittance or impedance matrix.
6. Apply load flow application for power system planning.
7. Use simulation tools to perform comprehensive short circuit and load flow studies.
8. Verify the power system variables as per electricity act.
9. Minimize the transmission and distribution losses for sustainable growth.

**Syllabus (Theory):**

**UNIT I: Per Unit System:** Per unit quantities. Impedance/Reactance diagram of a balanced for a balanced 3-phase system. Per unit impedance of 3-phase transformer.
**Admittance Model**: Equivalent admittance network and calculation of Y bus. Modification of an existing Y bus.
**UNIT II: Symmetrical fault Analysis**
Transient analysis of a transmission line, Short circuit analysis of a synchronous machine, Equivalent circuits of synchronous machine under sub transient, transient and steady state conditions, Fault analysis of an unloaded and loaded synchronous generator, balanced three phase fault analysis, Selection of circuit breaker.
**UNIT III: Sequence Components:** Fortesque theorem, symmetrical components, Sequence networks of transmission lines, Synchronous machine and Transformers, sequence networks of power system, Phase shift in star-delta transformers.
**Unsymmetrical Fault Analysis:** Classification of unsymmetrical faults, analysis of Unsymmetrical faults i.e. L-G, L-L, L-L-G faults, connection of sequence networks under the fault conditions. IEC 60909, ANSI/IEEE Short Circuit Studies standards

**UNIT IV: Power System Stability**

Steady state stability, transient stability, Power angle curve, equal area criterion, swing equation, Methods of improving stability, High speed fault clearing, regulated shunt compensation, dynamic braking, and Independent pole operation of circuit breaker, automatic voltage regulator.

**UNIT V: Load Flow Study**

Load flow problem, development of load flow equations, bus classification. Gauss Seidel, Newton-Raphson, decoupled and fast decoupled methods for load flow analysis. Comparison of load flow methods. IEEE30022018-1721251 load flow standard

**<u>Syllabus (Practical):</u>**

1. Introduction to MATLAB and its commands.
2. MATLAB program to solve swing equation using point by point method.
3. MATLAB program to find optimum loading of generators neglecting transmission loses.
4. MATLAB program to simulate Ferranti effect.
5. MATLAB program for formulation of admittance matrix.
6. MATLAB program to solve load flow equations by Gauss seidel method.
7. MATLAB program to solve load flow equation by Newton Rapson method.
8. MATLAB program for formulation of impedance matrix.
9. Modelling of DC Machines.
10. Modelling of Synchronous Machine.
11. Modelling of Induction Machine.

**<u>Course Assessment:</u>**

| **Prerequisites** | | Transmission and Distribution |
|---|---|---|
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | NIL |
| 2 | Assignment | 10 |
| 3 | Class Participation | NIL |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | 10 |
| 7 | Theory Exam-III | 20 |
| 8 | Report-I | NIL |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |

| | | |
|---|---|---|
| 11 | Project-I | 10 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 20 |
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**Textbooks:**


1. Kothari. D. P., Nagrath. I. J., "Power System Engineering", Tata McGraw-Hill Publishing Company Limited, 2nd Edition, Third Reprint, New Delhi, 2008.
2. Gupta, B.R., "Power System Analysis and Design", S. Chand & Company Ltd., Reprint Edition, New Delhi, 2007.
3. Hadi Saadat, "Power System Analysis", Tata Mc Graw-Hill Publishing Company limited, 2nd Edition, New Delhi, 2009.


**Reference books:**


1. Weedy B.M., Cory B.J., "Electric Power Systems", John Wiley & Sons Limited, 4th Edition, Reprint, England, 2009.
2. Wadhwa C. L., "Electrical Power Systems", New Age International Private Limited, 6th Edition, New Delhi, 2010.
3. J.D. Glover, M. Sarma, T. J. Overbye, Power System Analysis & Design, 4th Edition, Thomson Learning, 2008, ISBN: 0-534-54884-9 (includes all course software).
4. John Grainger, Jr., William Stevenson, Power System Analysis, McGraw-Hill

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE602 | Power System Switchgear & Protection | 3 | 0 | 2 | 4 |

**Course Outcomes:**

1. Equip students with the knowledge for application of Switchgear & Protection to power system protection.
2. Provide the essential strategies for preventive, diagnostic and remedial action to mitigate the identified risks.
3. Develop students' skills to design the protection schemes needed for each main part of a power system.

**Learning Outcomes:**

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

1. Identify and interpret the risks faced by power system equipment and associated loads as well as users and environment.
2. Plan preventive, diagnostic and remedial action to mitigate the identified risks.
3. Detect and diagnosis faults to take appropriate remedial action.
4. Analyze the construction, characteristics and application of various types of circuit breakers and relays. Also identify and provide solutions to complex problems associated with circuit breakers and relays.
5. Evaluate and choose appropriate circuit breakers and relays as per IEC standard.
6. Design protection monitoring subsystems for generators, transformer, bus bar and motors.
7. Conduct suitable experiments and plan protection schemes for transmission lines.

**Syllabus (Theory):**

**UNIT I: Introduction and Philosophy of Protective Relaying System**: Types of Faults, Functions of Protective Relays, Testing and Maintenance of Relays, Fuses, IEC60255 and BS142 standards

**UNIT II: Instrument Transformer:** Current transformer, potential transformer. Different Types of Relays: Electromagnetic relays, static relays.

**UNIT III: Circuit breakers:** Theory of circuit interruption, circuit constants in relation to circuit breaking, theory and practice of conventional circuit breakers, recent developments in circuit breakers, IEC60898 standards.

**UNIT IV: Protection:** Generator protection, transformer protection, protection of transmission lines, bus zone protection, and microprocessor based digital protection

**Syllabus (Practical):**

1. Study the burden effect on the performance of CT and measure ratio error.
2. Find out the sequence components of currents in three 1-Phase transformers and 3-Phase transformer and compare their results.
3. Checking characteristic and operation of Inverse Time Over Current relays having following characteristic Electromechanical relays (to be performed in Lab and Virtual Lab environment).
   a. Extremely Inverse relay (EI)
   b. Very Inverse Relay (VI)
   c. Normal Inverse Relay (NI)
4. Checking characteristic and operation of percentage bias differential and plot the characteristics of a percentage bias differential relay for 20%, 30% and 40% biasing.
5. Study gas actuated Buchholz relay.
6. Study under/over frequency relay and check it's setting experimentally.
7. Study a typical grid substation.
8. To study the earthing.
9. To study the directional over-current relay in virtual lab environment.
10. To find out dielectric strength of transformer oil in virtual lab environment.

**Assessment Scheme:**

| | | |
|---|---|---|
| **Prerequisites** | | Transmission and Distribution of Electrical Power |
| **Teaching Scheme (Hours per Week)** | | L T P(3 0 2) |
| **Credits** | | 4 |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | NIL |
| 2 | Assignment | 5 |
| 3 | Class Participation | 5 |
| 4 | Quiz | NIL |
| 5 | Theory Exam-I | NIL |
| 6 | Theory Exam-II | 20 |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | NIL |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | 20 |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 20 |
| 15 | Lab Evaluation-II | NIL |
| 16 | Course Portfolio | NIL |
| | **Total (100)** | 100 |

**References:**


1. B Ravindranath, M Chander, “Power System Protection and Switchgear” TMH publication.
2. C L Wadhwa,”Electrical Power System”, New age international publisher.
3. J B Gupta, “Transmission & Distribution of Electrical Power”, S. K. Kataria& Sons publication.
4. Sunil S. Rao, “Switchgear and Protection”, Khanna Publications New Delhi.
5. Y. G. Parithankarand S. R. Bhide, “Fundamentals of Power System Protection”, PHI.

<table>
<tr><th rowspan="2">Course code</th><th rowspan="2">Course Title</th><th colspan="4">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Credits</th></tr>
<tr><td>EE603</td><td>Industrial Electronics</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>

**Course Objectives:**

1. To study power semiconductor devices, their rating, and types for industrial use.
2. To have an idea about the principle and operation of various converter circuits, their applications in industrial drives.
3. To acquaint with industrial and domestic applications of power semiconductor devices.

**Learning Outcomes:**

1. Explain diode characteristics, models, operations, and applications in freewheeling and stored-energy recovery.
2. Design diode rectifiers circuits and phase-controlled rectifiers circuits for given load requirements.
3. Design different types of dc-dc converters.
4. Design switching circuits using transistors and thyristors.
5. Design and compare ac voltage controllers on the basis of on-off control and phase angle control.
6. Simulate and analyze all necessary Industrial Electronic circuits like rectifiers, regulators, inverters, cycloconverters, and choppers.
7. Test the performance of different circuits as per IEEE, IEC and other standards.
8. Improve the design of Industrial Electronic devices with a sensitivity to sustainability.

**Syllabus (Theory):**

**UNIT-I Power semiconductor devices:** Characteristics of SCR, gate trigger and communication circuits, series and parallel connection of SCRs, Diac, Triac, UJT, Power MOSFETS and IGBT, pulse transformer and isolation scheme, protection of power devices. Series & parallel operation of SCRs.

**UNIT-II Controlled Rectifier:** Single phase uncontrolled, half-controlled and fully controlled converters. three phase uncontrolled, half-controlled and fully controlled converters, Free–wheeling diode. IEC 62477-1:2012 Standard | Safety requirements for power electronic converter

**UNIT-III Choppers:** Principle of operation of chopper, types of choppers, commutation methods, **Regulators:** Single phase AC Regulators-different circuit configurations and their operation.

**UNIT IV Inverters:** Voltage & current source inverters, single phase half bridge and full bridge inverters, concept of feedback diode, three phase bridge inverters, PWM inverters, Series and

Parallel inverter. **Cyclo-converters:** Principle of Cyclo-converter operation, single phase to single phase Cyclo-converter circuit, Three-phase to single-phase and three-phase to three phase configurations. IEEE 519, IEC-1000 and other relevant standards

**UNIT V Applications of Industrial Electronics:** Switched mode power supply (SMPS), Uninterruptible power supplies, Solid state relays, Static circuit breaker, Over voltage protection, SCR current limiting circuit breaker, Time delay circuits, Fan regulator using TRIAC.

**Syllabus (Practical):**

1. Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.
2. Find V-I characteristics of TRIAC and DIAC.
3. Find transfer and output characteristics of MOSFET and IGBT.
4. Study and test firing circuits for SCR-R, RC and UJT firing circuits.
5. Study and test 3-phase diode bridge rectifier with R and RL loads. Study the effect of filters.
6. Study and obtain waveforms of single-phase half wave-controlled rectifier with and without filters. Study the variation of output voltage with respect to firing angle.
7. Study and obtain waveforms of single-phase half-controlled bridge rectifier with R and R-L loads. Study and show the effect of freewheeling diode.
8. Study and obtain waveforms of single-phase full controlled bridge converter with R and R-L loads.
9. Study Control the speed of a dc motor using single-phase half-controlled bridge.
10. Study of performance of PWM Inverter using MOSFET/IGBT as switch of 3-phase Induction Motor (simulation)

| Sr. No. | Evaluation Component | Marks |
|---|---|---|
| 1 | Theory Exam-I | 12 |
| 2 | Theory Exam-II | 12 |
| 3 | Theory Exam-III | 24 |
| 4 | Class Performance | 12 |
| 5 | Lab Performance | 24 |
| 6 | Lab Evaluation | 16 |
| | **Total (100)** | 100 |

**Textbook(s):**


1. Bimbhra P.S. "Power Electronics", Khanna Publisher.
2. Singh M.D. & Khanchandani K.B., "Power Electronics", Tata McGraw Hill.
3. Sen P.C., "Power Electronics", Tata McGraw Hill.

**Reference Book(s):**


1. M. Ramamurthy, “An Introduction to Thyristors and their Applications”, East West Press Pvt Ltd.
2. Mohammad H. Rashid, “Power Electronics Circuits, Devices and Applications”, Prentice Hall of India Pvt. Ltd.

| Course code and Title | | L | T | | P |
|---|---|---|---|---|---|
| **EE1206 Industrial Drive and E-Vehicle** | | 3 | 1 | | 2 |
| Theory Exam I | Theory Exam 2 | Continuous Evaluation | Project-1 | Project-2 | Total Marks |
| 10 | 10 | 30 | 25 | 25 | 100 |

**Syllabus (Theory):**

**UNIT I INTRODUCTION:** - Definition & classification of different type of drives, Dynamics of electrical drives, Review of characteristics and components of electric drives, acceleration and retardation time, energy consideration.

**UNIT II BRAKING OF DRIVES: -** Various methods of braking of a.c. and d.c drives, Automatic control arrangement, Speed control methods of various a.c. and d.c. drives, its advantages and applications.

**UNIT III INDUCTION MOTOR DRIVES: -** Basic principle of induction motor drives, 3 Ø a.c voltage controller fed I.M drive, variable frequency control, voltage source inverter (VSI) and current source inverter (CSI), cycloconverter fed IM drive, Slip Power control, static rotor resistance control, chopper control of 3 -Ø slip ring induction motor. IEC60034 standards.

**UNIT IV DC MOTOR DRIVES:** - Rectifier controlled circuits, Single phase fully controlled and half controlled rectifier fed separately excited d.c motor, 3Ø fully and half controlled fed separately excited d.c. multiquadrant operation of dc separately excited motor, Motor, performance and characteristics, Control techniques of d.c. Drives using chopper.

**UNIT V ELECTRICAL VEHICLES:** - Concept of electrical vehicles, Hybrid electrical vehicle, plug-in electrical vehicle, battery electrical vehicle., choice of motors for EVs, storage technology, Grid integration of EVs, Sensors for EVs, Introduction of tesla car. IEEE Standard 519-1992 Recommended Practices and Requirement.

**Text Book(s):**

1. G.K.Dubey," Fundamentals of Electric Drive". Narosa Publishing House.
2. Bimbhra.P.S. "Power Electronics" Khanna Publisher.
3. Singh M.D. & Khanchandani K.B. "Power Electronics" Tata McGraw Hill
4. Sen P.C. "Power Electronics", Tata McGraw Hill
5. Chau K.T. "Electrical Vehicle Machines and Drives Design, Analysis and Application", Willey, IEEE Press.

**Reference Book(s):**


1. M. Ramamurthy: An Introduction to Thyristors and their Applications, East West Press Pvt Ltd.
2. Mohammad H. Rashid: Power Electronics Circuits, Devices and Applications, Prentice Hall of India Pvt Ltd.
3. Seth Leitman Bob Brant: Build Your Own Electrical Vehicle, Tata McGraw Hill.

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| EE1205 | TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT | 3 | 1 | 0 | 4 |

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

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

**<u>Syllabus (Theory):</u>**

**UNIT I Installation of Electrical Equipment:** Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding. Earthing of substation, generating station and overhead line.

**UNIT II Testing and Commissioning of Transformers:** Testing procedure for HV testing, Phase shifting/ phase group, Radio interference, Ratio Test, Load loss, Separate source voltage testing , Induced voltage testing, Impulse and Surge testing, Noise level and vibration testing , Short circuit withstand test ,Tan Delta test , Core insulation voltage test,, Oil testing ,Classification of testing methods , Testing of bushing. DC and AC Resistance measurement, Dielectric test, Partial discharge, Insulation resistance testing. Polarity testing, Short time current rating, Impulse and surge testing, Determination of error and accuracy class, Power frequency voltage withstand test, Determination of polarization index for transformer. IEC standards and IEC60076 standards.

**UNIT III Testing and Commissioning of Induction Motor:** Degree of protection, cooling system, degree of cooling with IP- IC code, installation, commissioning and protection of induction motor, hammer test, Testing against variation of voltage/current/frequency, Load test, No load and Block rotor test, DC and AC, Resistance measurement, Insulation measurement, Starting test, Temp. Rise test, Slip measurement, Drying out methods / Polarization Index / Hot Temperature measurement, Commissioning steps for Induction motor, Troubleshooting and maintenance of induction motor. IEC60 standards

**UNIT IV TESTING OF CABLE:** De-rating of cable capacity, HV test, AC and DC Resistance check, Insulation resistance, Impedance measurement, Location finding technique for fault in underground cables (Murray loop test and Warley loop test).

**Textbook(s):**


1. Rao, S., “Testing, commissioning, operation and maintenance of electrical equipment”, 6/E., Khanna Publishers, New Delhi
2. Paul Gill, “Electrical power equipment maintenance and testing”, CRC Press, 2008.
3. Naidu M. S. and Kamaraju V., “High Voltage Engineering”, fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2009.
4. Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers, New Delhi, 2010.


**Reference Books:**


1. M. Khalifa, "High Voltage Engineering-Theory and Practice", Marcel Dekker, Inc. New York and Basel, 1990.
2. Hugh M. Ryan, “High Voltage Engineering and Testing”, 2nd edition, The Institution of Electrical Engineers, London, United Kingdom, 2001.
3. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
4. Philip Kiameh, “Electrical Equipment Handbook: Troubleshooting and Maintenance”, McGraw-Hill, 2003.
5. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipments/machines.
6. IS 4029:2010-Guide for Testing Three Phase Induction Motors; IS 7132:1973-Guide for Testing Synchronous Machines; IS 9320:1979-Guide for Testing of Direct Current (dc) Machines
7. IS 2026: Part_1-10-Power Transformers: Methods of Test; IS 13956:1994-Testing Transformers.

| Course code: EE1202 Electrical Systems Design | | | | | | |
|---|---|---|---|---|---|---|
| Course Title | Teaching Scheme | L | T | P | S | Credits |
| | | 3 | 0 | 0 | 0 | 4 |

**This course is suitable for:**

- Students wanting to learn about the real-world application of electrical design
- Safety officers who want to understand the principles of site electrical systems and how to operate them safely

**Course Objectives:**

The goal of this course is to discuss electrical system planning and design, lighting design, internal electrification design, equipment selection and switch yard design, Sensors identification for automation and communication devices. Develop understanding of the Acts and regulations for Electrical system designing. This course will facilitate students to design and analysis the electrical systems.

**Learning Outcomes:**

1. Explain the National lighting code, IS code, rules and regulations
2. knowledge of acts and rules used for regulating the electrical supply in our country
3. Apply the acts in accordance with the risk and safety issues, legal obligations codes of safety practice.
4. To design and estimation of low voltage and medium voltage electrical installations.
5. Formulate the suitable methodologies to selection of distribution transformers and their installations.
6. To Design internal electrification and air-conditioning system for domestic, commercial and industry consumers
7. To design the Earthing systems in different installations and the standard dimensions of earthing systems.
8. Review the design of existing electrical systems as per the standard electrical safety code.
9. Integrate the sensors for the monitoring and automation of electrical systems.

**Syllabus:**

**Unit-I: System Planning** Basic design considerations, voltage selection, costs. General aspects of the design of electrical installations for domestic, commercial and industrial consumers, calculation of voltage drops. Preparing the cost estimate: classes of estimates, equipment and material, installation. Pre-commissioning tests of domestic installations. National Lighting Code (NIC), IS codes for lighting and interior illumination.

**Unit-II: Lighting Design** Light sources, laws of illumination, interior lighting, exterior lighting, utility services, different types of loads and their individual protections, selection of cable/wire sizes, Design of illumination systems: Yard lighting, street lighting and flood lighting, design and layout of installation for recreational or assembly buildings, cinema theatre and high-rise building. Design of Electrical system related to firefighting, lifts and escalators.

**Unit-III: Internal Electrification Design** Electrical layout in residential building using Auto CAD, Selection of house wiring, sizing of conduit, switch/socket, Calculation of load on circuit, Design of sub circuit (Lighting/Power circuit), Calculation of fan, design of Earthing, Selection of low voltage switchgears, design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators.

**Unit-IV: Equipment Selection** Selection and installation of transformers, Installation of induction motors, Design of automatic power factor correction (APFC) Panel, Design of indoor and outdoor 11 kV substation upto 630 kVA.
Air-conditioning systems, Size and load calculation, design of air-conditioning system for domestic/theatres, Energy conservation techniques. Pre-commissioning tests of cables, transformers and generators, Selection of UPS and Generators.
Design of Sensor Network, Substation Automation system design, Selection of PLC, Communication protocol, Substation Automation with ICE 61850 Standard, Power line carrier Equipment (PLCC).

**Unit-V: Design and Engineering of Switchyard** Selection of project, Classification, Electrical clearance of substation, Insulation coordination calculation of Equipment, Outdoor substation Layout, bus-bar schemes, Sizing of Transformers, Reactive Compensation Equipment, Selection of Current/Voltage Transformers for switchyards, HT/LT Circuit Breaker, Control and Relay Panels, Protection Schemes for Substation, Lightning Protection, Selection of Insulators, Earthing of Switchyard, Cabling of Switchyard, Fire protection Facilities in Substation, DC supply/ Battery bank Sizing.

**Course Evaluation for Electrical System Design**

| | | |
|---|---|---|
| **Prerequisites** | | Basics of Electrical Engineering |
| **Teaching Scheme (Hours per Week)** | | L T P (3 0 0) |
| | **Credits** | 03 Credits |
| **Sr. No.** | **Evaluation Component** | **Marks** |
| 1 | Attendance | - |
| 2 | Assignment | 05 |
| 3 | Class Participation | 05 |
| 4 | Quiz | 10 |
| 5 | Theory Exam-I (Mid Term) | 10 |
| 6 | Theory Exam-II (End Term) | 30 |

| | | |
|---|---|---|
| 7 | Report-I (case study) | 10 |
| 8 | Report-II | 10 |
| 10 | Project-I | 10 |
| 11 | Project-II | 10 |
| | **Total (100)** | 100 |

**References:**


1. National Electric Code, Bureau of Indian Standards publications.
2. M.K. Giridharan, Electrical Systems Design, I K International Publishers, New Delhi.

## CS2405: Deep Learning

| Course Title and Code: Deep Learning, CS2405 | |
|---|---|
| **Hours per Week** | **Curated MOOC (approx. 11 Hrs. per week)** |
| Credits | **5** |
| Students who can take | **Pre-Ph.D, Post Graduate, B.Tech Under graduate (Final Year)** |

**Course Objective:** This course includes the foundations of Deep Learning, building of neural networks, and discussion of successful machine learning projects. Students will learn about Convolutional networks, RNNs, LSTM, Adam, Dropout, BatchNorm, Xavier/He initialization, and more. Students will master not only the theory, but also see how it is applied in industry. Course includes practice of all these ideas in Python and Tensor-Flow.

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

1. Identify Deep learning techniques (Convolutional networks, RNNs, LSTM, Adam, Dropout, BatchNorm, Xavier/He initialization) suitable for a given problem.
2. Find creative ways to apply deep learning to solve real life problems.
3. Appreciate the underlying mathematical relationships within and across Deep Learning algorithms.
4. Utilize Reinforcement Learning concepts to improvise precision of models.
5. Analyze Case studies from healthcare, autonomous driving, sign language reading, music generation, and natural language processing.

**erequisites: Linear Algebra, Basic Statistics, Programming Langauge (Python), Artificial Intelligence, Machine Learning**

**valuation Scheme**

| Sr. No | Specifications | Marks |
|---|---|---|
| 1 | Attendance | Nil |
| 2 | Assignment | 20 |
| 3 | Class Participation | Nil |
| 4 | Quiz | Nil |
| 5 | Theory Exam I | Nil |
| 6 | Theory Exam | Nil |
| 7 | Theory Exam (End Term) | 30 |
| 8 | Report-1 | Nil |
| 9 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | 40 |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | Nil |
| 15 | Lab Evaluation2 | 10 |
| 16 | Course portfolio | Nil |

| | | |
|---|---|---|
| | **Total (100)** | **100** |

**Retest**

| | | |
|---|---|---|
| 1 | Theory Exam | 30 |
| 2 | Lab Evaluation | 10 |

**Course Contents:**

Introduction to Deep Learning, Neural Network Basics, Shallow Neural Networks, Improving Deep Neural Networks: Hyperparameter tuning, Regularisation and Optimisation, Practical Aspects of Deep Learning, Optimisation Algorithms, Hyperparameter tuning, Batch Normalisation and Programming Frameworks, Structuring Machine Learning Projects

Foundations of Convolutional Neural Networks: Deep Convolutional Models: Case studies, Object Detection: Special Applications: Face Recognition and Neural Style Transfer, Sequence Models, Recurrent Neural Networks

Natural Language Processing and Word Embeddings, Sequence models and Attention Mechanism

**Suggested Reading Materials:**

This course is regularly delivered on coursera by Andrew Ng, Founding Lead of Google Brain along with instructors at DeepLearning.ai. The specialization is divided into 5 courses with an approximate completion time of 3 months requiring a study time of 11
hours per week.

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME301 | Engineering Thermodynamics | 3 | 1 | 0 | 0 | 4 |

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

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

**UNIT-I**

**Basic Concepts-** Macroscopic and Microscopic Approach, Systems, Surrounding and Boundary, Property, Equilibrium, State, Path, Process and Cycle, Reversible and Irreversible Processes, Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility.

**Ideal and Real Gases-** Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avagadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, law of corresponding states, Mixture of Gases, Mole and Volume Fraction, Gibson Dalton's law.

**UNIT-II**

**First Law of Thermodynamics-** Energy and its Forms, 1$^{st}$ law of Thermodynamics, Internal Energy and Enthalpy, 1$^{st}$ Law Applied to Non-Flow Process and Steady Flow Process, Throttling Process and Free Expansion Process.

**UNIT-III**

**Second Law of Thermodynamics-** Limitations of First Law, Heat Source and Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot's Theorem and its Corollaries.

**Entropy-** Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics.

**UNIT-IV**

**Availability, Irreversibility and Equilibrium-** High- and Low-Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility.

**Thermodynamic Relations- Tds** Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations

**UNIT-V**

**Pure Substance-** Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots during Steam formation, Properties of Dry, Wet and Superheated Steam, Property Changes during Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.

**Textbook(s):**

1. D S Kumar, "Thermal Science and Engineering" S K Kataria and Sons.
2. C P Arora, "Engineering Thermodynamics" Tata McGraw Hill.
3. Nag P.K., "Engineering Thermodynamics" Tata McGraw Hill Publishing Co. Ltd.

**Reference Book(s):**

1. Van Wylen, G.J. and Sonntag, R.E., "Fundamentals of Thermodynamics" John Wiley & Sons.
2. Holman, J.P., "Thermodynamics" McGraw-Hill book Co. New York.
3. Congel & Boles, "Engineering Thermodynamics" Tata McGraw Hill.

**Web link:**

1. https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLeRx4palfirbdOTXXYf4MoW3eM4dFIgR9
2. https://www.mooc-list.com/course/me209x-thermodynamics-edx
3. https://www.coursera.org/learn/thermodynamics-intro

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME306 | Strength of Materials | 3 | 1 | 2 | 0 | 5 |

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

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

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

**UNIT I**

**Simple Stresses & Strains-** Composition and resolution of Forces, Equilibrium of Forces, Poisson's ratio, Elastic Constants & their Relationship, Compound bars, Stress-Strain diagram, Temperature stresses, Numerical.

**Compound Stress & Strain-** Volumetric Strain, Principal Stress and Strain, Mohr's Circle of stresses.

**UNIT II**

**Torsion-** Torsion of hollow and solid Circular Shaft within elastic limit, Thin Shaft, Tapered Shaft, Composite Shaft, Torque and Horsepower, angle of twist, Torsion equation, Assumptions, Numerical.

**UNIT III**

**Bending and Shearing stresses in beam-** Types of beams, types of loading, Moments and their applications, Parallel Forces and Couples, Support Reactions, Relation between Rate of loading the Shear force and Bending Moment, Numerical.

Theory of simple bending, Flexure formula, Section Modulus, Composite beam in Circular, Rectangular, I, T, & Channel Section, Shear stress Distribution, Combined Stresses in beam, Numerical.

**Slope & Deflection -** Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

**UNIT IV**

**Columns & Struts-** Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Eulers formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

**UNIT V**

**Thin Cylinders & Spheres-** Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire would cylinder, Numerical.

**Springs-** Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numerical Problems.

**Syllabus (Practical):**

1. Universal Testing Machine UTE-20.
2. Impact Tester, IT-30.
3. Torsion Testor, TTE-10.
4. Rockwell Hardness Tester.
5. Brinell Hardness Tester.
6. Vickers Hardness Tester, VM-50.
7. Fatigue Testing machine, FTG 8(D).
8. Bending Stress in a Beam, STR 5.

**Textbook(s):**

1. Hibbeler, R.C., **"Mechanics of Materials SI",** Prentice Hall.
2. Beer, F.P., Johnston, E.R., DeWolf, J.T., "**Mechanics of Materials**", McGraw Hill.
3. Rattan, S.S., **"Strength of Materials**", McGraw Hill, New Delhi.

**Reference Book(s):**

1. Andrew Pytel and Fredinand L. Singer, "Strength of Materials" Int. Student Ed.
2. Popov, "Strength of Materials" PHI, New Delhi.
3. Sadhu Singh, "Strength of Materials" Khanna Publications.
4. Dr. R. K. Bansal, "Strength of Materials" Laxmi Publications.

**Weblink:**

1. https://www.youtube.com/watch?v=A1SWKe6ZwVc&list=PL2D5AE008C055CC4F
2. https://www.youtube.com/watch?v=GkFgysZC4Vc&list=PL27C4A6AEA552F9E6
3. https://www.springboard.com/udemy/mechanical-strength-of-materials/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME308 | Fluid Mechanics & Machines | 3 | 1 | 2 | 0 | 5 |

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

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

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

**UNIT I**

**Fluid Properties and Fluid Statics-** Concept of fluid, ideal and real fluids, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium.

**UNIT II**

**Fluid Kinematics-** Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, stream and potential functions, flow net.

**UNIT III**

**Fluid Dynamics-** Concept of system and control volume, Euler's equation, Bernoulli's equation, Pitot tube, venturimeter, orificemeter, flow through orifices & mouthpieces, Hagen-Poiseuilli Law, hydraulic gradient and total energy lines, major and minor losses in pipes. Power transmission though pipes, branched pipes- parallel and series.

**UNIT IV**

**Boundary Layer Analysis**- Boundary layer concept, displacement, momentum and energy thickness of boundary layer. Laminar and turbulent boundary layer flows drag on a flat plate, boundary layer separation and control. Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes.

**UNIT V**

**Fluid Machines-** Analysis and design of rotodynamic pumps and turbines, Specific speed, Performance characteristic curves and selection of pumps and turbines, Single and multi-stage machines, Various head losses and respective efficiencies, Cavitations, Governing of turbines and priming of rotodynamic pumps, Analysis and design of reciprocating pumps and other machines such as hydraulic accumulator, coupling and torque converter, Performance characteristics and efficiencies

**Syllabus (Practical):**

1. To determine coefficient of discharge of an orificemeter.
2. To determine the coefficient of discharge of Notch (V and Rectangular types).
3. To determine the friction factor for the pipes.
4. To determine the coefficient of discharge of venturimeter.
5. To verify the Bernoullis Theorem.
6. To find critical Reynolds number for a pipe flow.
7. To determine the meta-centric height of a floating body.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To draw the following performance characteristics of Pelton turbine-constant head, constant speed and constant efficiency curves.
10. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.
11. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
12. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.
13. To study the construction details of a Gear oil pump and its performance curves.
14. To study the constructional details of a Hydraulic Ram and determine its various efficiencies.

**Textbooks:**

1. D S Kumar, "Fluid Mechanics and Fluid Power Engineering" S K Kataria and Sons.
2. Modi & Seth, "Hydraulics & Fluid Mechanics" Standard Book House.
3. S S Rattan, "Fluid Mechanics and Hydraulic Machines" Khanna Publishers.

**Reference Books:**


1. Streeter V L and Wylie E B, "Fluid Mechanics" Mc Graw Hill.
2. I H Shames, "Mechanics of Fluids" Mc Graw Hill.
3. S K Som and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines" Tata McGraw Hill.


**Web Link:**

1. https://www.youtube.com/watch?v=HGbbdXNcIQA&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt
2. https://www.youtube.com/watch?v=fa0zHI6nLU0&list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm
3. https://www.class-central.com/mooc/5291/nptel-introduction-to-boundary-layers
4. https://www.class-central.com/mooc/6562/nptel-fluid-machines
5. https://legacy.saylor.org/me201/Intro/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME305 | Machine Drawing | 0 | 0 | 4 | 0 | 2 |

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

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

Introduction to Bureau of Indian Standards (BIS) of engineering drawing, Limits fits and tolerances (linear and geometric tolerances), surface finish symbols and their elements.

**Gears-** Gear terminology, IS conventions, representation of assembly of spur gears, helical gears, bevel gears, worm and worm wheel.

**Fasteners-** Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints.

Orthographic views from isometric views of machine parts / components, exercises on Couplings, Cotter and knuckle joint, Riveted Joints and Welded Joints.

**Assemblies drawing with sectioning and bill of materials from given detail-**

a) **Couplings-** Solid or rigid Coupling, Protected type flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.
b) **Lathe tail stock, Machine vice, Pedestal Bearing, Steam stop Valve, Drill Jigs and milling fixtures.**
c) **Pipe and Pipe fittings-** flanged joints, spigot and socket joint, union joint, an expansion joint
d) **IC Engine Parts-** Piston, connecting rod
e) **Boiler Mountings-** steam stop valve, feed check valve, safety valve, blow off cock.
f) **Bearings-** swivel bearing, thrust bearing, Plunger block, angular plumber block
g) **Miscellaneous-** Screw Jack, Drill Press Vice, Crane hook.

**Syllabus (Practical):**

**Assemblies drawing with sectioning and bill of materials from given detail:**

1. **Couplings-** Solid or rigid Coupling, Protected type flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.
2. **Lathe tail stock, Machine vice, Pedestal Bearing, Steam stop Valve, Drill Jigs and milling fixtures.**
3. **Pipe and Pipe fittings-** flanged joints, spigot and socket joint, union joint, an expansion joint
4. **IC Engine Parts-** Piston, connecting rod
5. **Boiler Mountings-** steam stop valve, feed check valve, safety valve, blow off cock.
6. **Bearings-** swivel bearing, thrust bearing, Plunger block, angular plumber block
7. **Miscellaneous-** Screw Jack, Drill Press Vice, Crane hook.

**Textbooks:**


1. Basudeb Bhattacharyya, *"Machine Drawing including AutoCAD Supplements,"* Oxford University Press
2. Ajeet Singh, *"Machine Drawing: Includes AutoCAD"* TMH


**Reference Books:**


1. Yarwood, Alf *"Introduction to Auto – CAD 2011 2D and 3D Design"* Elsevier
2. Ellen Finkelstein, *"Auto-CAD 2011 & Auto-CAD LT 2011 Bible"* Wiley India Edition
3. Bhatt, N.D. *"Machine Drawing"* Charotar Publisher
4. James E Fuller, *"Using Auto-CAD"* Denmark Publishing Co.
5. Dhawan, R.K. "*Machine Drawing*", S. Chand and Co
6. Radhakrishnan, P. *"Computer Graphics and Design*", Dhanpatrai and Sons


**Web link:**

1. https://www.youtube.com/watch?v=40LzESl_s0Q&index=3&list=PLkdR-HWBK35cbV2R4nOt4C0oRf70B0ngn
2. https://www.youtube.com/watch?v=RGr2vzch-SI
3. https://www.youtube.com/watch?v=Y6cIGRrqCvc&list=PLItCiRV7ABU7PvUkCA z6 UCWlvKyMOR6

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME408 | Heat Transfer | 3 | 1 | 2 | 0 | 5 |

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

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

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

**UNIT I**

**Introduction to Heat Transfer Processes-** Conduction and radiation, Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity, Newton's law of cooling, definition of overall heat transfer coefficient, general parameters influence the value of heat transfer coefficient. Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates, different kinds of boundary conditions, nature of differential equations, one dimensional heat conduction with and without heat generation, electrical analogy, heat conduction through composite walls, critical thickness of insulation.

**UNIT II**

**Heat Transfer from Finned Surfaces-** fin efficiency and effectiveness, two-dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction. Convection: Review of Navier–Stokes and energy equation, hydrodynamic and thermal boundary layers, laminar boundary layer equations, forced convection appropriate non dimensional members, effect of prandtl number, empirical relations for flow over a flat plate and flow through pipes.

**UNIT III**

**Natural Convection-** Dimensional analysis, grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations. Heat Transfer with Change of Phase: Nature of vaporization phenomena, different regimes of boiling heat transfer, correlations for saturated liquid vaporization, condensation on flat plates, correlation of experimental results, drop wise condensation.

**UNIT IV**

**Heat Exchanger-** Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger, effectiveness of heat exchanger, N.T.U. method, fouling factor, constructional and manufacturing aspects of Heat Exchangers.

**UNIT V**

**Thermal Radiation-** Plank distribution law, Kirchhoff's law, radiation properties, diffuse radiations, Lambert's law, radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies, shape factor, electrical analogy, reradiating surfaces heat transfer in presence of reradiating surfaces.

**Syllabus (Practical):**

1. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
2. To Measure the thermal Conductivity of Liquid.
3. To determine the transfer Rate & Temperature Distribution for a Pin Fin.
4. To Measure the Emmissivity of the Test plate Surface.
5. To Determine Stefan Boltzman Constant of Radiation Heat Transfer.
6. To Determine the Surface Heat Transfer Coefficient for Heated Vertical Cylinder in Natural Convection.
7. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.
8. To Study Performance of Simple Heat Pipes.
9. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10. To Find the Heat Transfer Coefficient in Forced Convection in a tube.

**Textbook(s):**

1. Holman J.P. "Heat Transfer" Tata McGraw-Hill, New Delhi.
2. Cengel "Heat and Mass Transfer" Tata McGraw-Hill, New Delhi.

**Reference Book(s):**

1. Kumar D.S. "Heat and Mass Transfer" Kataria and Sons.
2. Nag P.K. "Heat and Mass Transfer" Tata McGraw-Hill, New Delhi.
3. Thirumaleshwar M. "Fundamental of Heat and Mass Transfer" Pearson Education.
4. Rajput R.K. "Heat Transfer" S. Chand Publication.

**Web link:**

1. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785

2. https://www.springboard.com/udemy/mechanical-heat-and-mass-transfer/
3. https://www.class-central.com/mooc/5302/nptel-conduction-and-convection-heat-transfer

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2" colspan="4">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>ME405</td><td colspan="4">Production Technology - I</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="5">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test – I</td><td>Mid Term Test -II</td><td>End Term Test</td><td>Class Participation/ Additional Continuous Evaluation*</td><td>Total Marks</td><td>Mid Term Test - I</td><td>End Term Test</td><td colspan="2">Class Participation/ Additional Continuous Evaluation</td><td>Total Marks</td></tr>
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</table>

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

**UNIT I**

Manufacturing Cycle. Manufacturing Process and their selection, Engineering Materials and their selection.

**UNIT II**

**Patterns-** Pattern types, allowances for pattern, pattern materials,
**Moulding methods and machines**, Moulding sand testing, Machine moulding, core moulding, shell moulding, investment moulding, plaster of Paris moulding,
Mould design. Gating system design, riser design.
**Other Casting Methods-** Investment casting, die casting, centrifugal casting, and continuous casting. Casting Defects & Remedies. **Melting Furnaces**: Design and Operation.

**UNIT III**

**Lathe-** Type of lathe, Lathe specifications, Lathe operations, Lathe centers, Mandrels, Chucks, Collets, Face plates, Steady and Follow rests, Tool holders, Automatic mass production lathes classification and operations, Turrets classification and operations, Drilling Machine, Geometry of Twist Drills, Boring, Reaming, Spot facing, Counter Sinking and Counter Boring. Shaping and Planers and their operating mechanisms,

**UNIT IV**

**Welding-** Introduction to Welding, Classification of Welding Processes, Gas Welding, Oxy-Acetylene Welding, **Solid state welding processes**, Brazing and soldering. Adhesive bonding, Mechanical fastening processes.
**Resistance welding processes-** Resistance Welding; Spot and Seam Welding, Arc Welding, Metal Arc, TIG & MIG Welding, Submerged arc welding (SAW), resistance welding principles, electrode types and selection, thermit welding, electro slag welding, forge welding, friction welding, Welding Defects and remedies

**UNIT V**

**Metrology-** Measurement, linear and angular simple measuring instruments, various clampers, screw gauge, sine bar, auto-collimator, comparator- mechanical, electrical, optical, surface finish and its measurements, micro and macro deviation, factors influencing surface finish and evaluation of surface finish. . Concept of limits fits and tolerances, Types of fits, Universal and local interchangeability, Systems of limits, fits and tolerances, Selective assembly and matched fits, B.S., I.S.O. and I.S. systems.

**Syllabus (Practical):**

1. Perform (Find out)
   a) Moisture content in moulding sand,
   b) The clay content of moulding sand,
   c) Permeability of the mould
   d) Strength test (compressive, Tensile, Shear Transverse etc. in green and dry conditions).
   e) Hardness Test (Mould and Core).
2. To cast a liquid Aluminum metal by using sand moulding (Prepare the mold with the help of Pattern: with all the necessary allowances, and should have parting line, running system details) and die casting methods.
3. Investigate the casting defects and suggest the remedial measures.
4. To make a component involving horizontal and vertical welding using gas welding, TIG and MIG welding.
5. Development and manufacture of complex sheet-metal components such as funnel etc.

**Textbook(s):**

1. Ghosh and Malik “Manufacturing science “E.W. Press
2. P.N. Rao “Manufacturing Technology: Foundry, Forming and Welding” TMH.
3. James S. Campbell “Principles of Manufacturing Materials and Processes” TMH.
4. G.E. Linnert, “Welding Metallurgy” AWS.

**Reference Book(s):**

1. Cook “Manufacturing analysis” Adisson-Wesley
2. R. K. Jain “Manufacturing Engineering Technology” Pearson Education
3. P. C. Pandey and C. K. Singh “Production Engineering Sciences” Standard Publishers Ltd.
4. A. Ghosh and A. K. Mallick “Manufacturing Science” Wiley Eastern

**Web Link:**

1. https://www.youtube.com/watch?v=uRVaLUQUmA8&list=PLACB124F79F677B6A
2. https://www.youtube.com/watch?v=FLNazQcBwLM
3. https://www.class-central.com/mooc/5289/nptel-manufacturing-process-technology-part-i

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<tr><th>L</th><th>T</th><th>P</th><th>S</th><th>Credits</th></tr>
<tr><td>ME411</td><td>Mechanical Measurements</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
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</table>

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

**Unit I**

**Basic Concepts of Measurement-** General measurement system; Experimental test plan: variables, parameters, repetition; Calibration: Static calibration, dynamic calibration, static sensitivity, range, accuracy, precision and bias errors, sequential and random tests; Presenting data: Rectangular coordinate format, semi-log, full-log formats. Measurement System Behavior.

**Unit II**

**Temperature Measurement-** Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards.

**Unit III**

**Pressure and Velocity Measurement-** Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids Flow measurement: Pressure differential meters: Orifice meter, Venturi meter, roto-meter.

**Unit IV**

**Strain Measurement-** Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple gauge bridge, bridge constant, apparent strain and temperature compensation, bending compensation. Motion, Force and Torque Measurement: Displacement measurement: Potentiometers, Linear variable differential transformers, rotary variable differential transformer; Velocity measurement: moving coil transducers; angular velocity measurement: electromagnetic techniques, stroboscopic measurement; Force measurement: load cells, piezoelectric load cells;

Torque measurement: measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

**UNIT-V**

**Linear measurement-** standards of linear measurement, line and end standards, Limit, fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices, sine bar and system comparators: Sigma, Johansson's Microkrator. Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope, profile projector, autocollimator.
Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears.

**Syllabus (Practical):**

1. Study of various temperature measuring devices; thermo couple, RTD, gas thermo meters.
2. Measuring velocity of fluid flow by Ventura meter/ orifice meter/ pitot-tube.
3. Measuring torque and power generated by a prime mover by using pony brake dynamometer.
4. Study of various pressure measuring devices like manometers, mercury in glass pressure gauge.
5. To develop a measuring device for fluid level measurement.

**References:**

1. Nakra and Chowdhry "Measurement and Control" TMH
2. Figiola RS & Beasley DE "Theory and Design for Mechanical Measurements" John Wiley
3. Katsuhiko Ogata "Modern Control Engineering" Pearson Education, New Delhi
4. Backwith and Buck "Mechanical Measurements".
5. Swahney "Metrology and Instrumentation"

**Web Link:**

1. https://www.youtube.com/watch?v=lc4dsNvm2Ks&list=PL70EFDD69A84246B0
2. https://www.youtube.com/watch?v=8DTt-f6wQxE&list=PL522E677B167D6CB5
3. https://www.youtube.com/watch?v=SOHTg9EFE5g&list=PL3txkL3SesVb4YIHlK-COA3drxidb-mb3
4. http://nptel.ac.in/courses/112106138/

5. http://www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html
6. http://www.qimtonline.com/course/index.php?categoryid=84

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>ME410</td><td>Materials Science & Engineering</td><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
</table>

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</table>

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

**UNIT I**

**Crystallography-** Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numerical related to crystallography

**UNIT II**

**Imperfection in metal crystals-** Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

**Solid solutions and phase diagram-** Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

**UNIT III**

**Heat Treatment-** Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, hardenability, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

**UNIT IV**

**Deformation of Metal-** Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking. Recovery, re-crystallization and grain growth

**Failures of metals-** Process of fracture, types of fracture, fatigue failure, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue, failure analysis.

**UNIT V**

**Creep and Corrosion-** Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism, types of corrosion, effect of corrosion, prevention of corrosion.
**Engineering alloys-** Heat resistant, corrosion resistant, super alloys, carbon and alloys tool steels and high-speed steels, ceramics: preparation and applications

**Textbooks:**


1. George E. Dieter "Mechanical Metallurgy"
2. V. Raghvan "Material Science & Engineering" Prentice Hall of India Pvt. Ltd, New Delhi
3. Narula, Narula and Gupta "Material Science" New Age Publishers
4. O.P. Khanna "A Textbook of Material Science & Metallurgy" Dhanpat Rai & Sons


**Reference Books:**


1. Callister; W.D. "Material Science and Engineering-An Introduction", John Wiley & Sons, Delhi.
2. Kenneth G. Budinski "Engineering Materials" Prentice Hall of India, New Delhi


**Web Link:**

1. https://www.youtube.com/watch?v=b4jvpYxxZco&list=PLE34EAAA410160DD6
2. https://www.youtube.com/watch?v=RJ-OCEz7wd0&list=PLbMV0gVj5nJQ5jqiXDYuE6ETz5F5Kn4dA
3. https://www.youtube.com/channel/UC9sKRSg8Kn5axYdORJUnqFw
4. https://ocw.mit.edu/courses/materials-science-and-engineering/
5. https://www.pearsonhighered.com/product/Shackelford-Introduction-to-Materials-Science-for-Engineers-8th-Edition/9780133826654.html
6. https://www.springboard.com/udemy/core-materials-science/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Cred its |
| **MA405** | **Engineering Optimization** | **3** | **0** | **2** | **0** | **4** |

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

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

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

**Unit I**

**Linear Programming Problems-** Introduction to Optimization and its scope, Formulating a Mathematical Model, Graphical Solution, Simplex Method, Duality Theory, Dual Simplex Method, Transportation Problem, Assignment Problem

**Unit II**

**Non-Linear Programming Problems-** Introduction, Single variable and multi variable optimization, Constrained and unconstrained problems, Kuhn-Tucker conditions, Dynamic Programming

**Unit III**

**Project and Simulation-** Simulation, Project Management with CPM/PERT

**Unit IV**

Introduction to Evolutionary Algorithms

Nature Inspired Algorithms- Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization.

**Unit V**

**Engineering Applications-** Inventory Theory, Optimization in Mechanical Engineering, Case Study

**Syllabus (Practical):**

Problem solving using various software packages for the following areas.

1. Linear Programming
2. Non-linear Programming
3. Engineering problems solving
4. Case Study

**Textbooks and Reference books:**


1. S S Rao "*Engineering Optimization: Theory and Practices*" New Age International.
2. Hillier F.S. and Lieberman G.J. "*Introduction to Operations Research: Concepts and Cases*" Tata McGraw Hill,
3. Taha. H. A "*Operations Research: An Introduction"* Pearson Education
4. Ronald L. Rardin "*Optimization in Operations Research"* Pearson Education
5. Pant. J.C. *"Introduction to Optimization: Operations Research"* Jain Brothers.
6. Sharma. S. D. "*Operations Research*" Kedarnath Ramnath & Co.
7. Kalyanmoy Deb "*Optimization for Engineering Design: Algorithms and Examples"* PHI.
8. Kasana H.S. and Kumar K.D. "*Introductory Operations Research: Theory and Applications"* Springer.


**Web Link:**


1. https://www.youtube.com/watch?v=4U3B5lr-MqM&list=PLE1A690CCA8279F89
2. https://www.youtube.com/watch?v=4s3Ks-yNufc&list=PLbMVogVj5nJT8iTaUR8FoWBuJy0vs-Z3C
3. https://www.mooc-list.com/course/fundamentals-quantitative-modeling-coursera
4. https://www.mooc-list.com/course/cvx101-convex-optimization-stanford-university

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME509 | Applied Thermodynamics | 3 | 1 | 2 | 0 | 5 |

| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | |
|---|---|---|---|---|---|---|---|---|
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**Syllabus (Theory):**

**UNIT-I**

**Vapour power cycle-** Review of Carnot and Rankine cycle, Effect of operating conditions on thermal efficiency of Rankine cycle, Principle methods of increasing thermal efficiency, Deviation of actual cycle from theoretical cycle, Efficiencies, Requirement of ideal working fluid, Binary vapour cycle, Regenerative feed heating cycles, Calculation of mass of bled steam, Optimum feed water temperature, temperature distribution in feed heaters, Deaerators, Effect of flow of wet Steam in nozzles and blades, Erosion and corrosion of blades and its prevention, Reheating and regenerative cycles, Practical feed heating systems.

**UNIT-II**

**Flow through nozzles and diffusers- Classification** of nozzles and diffusers. Steady flow energy equation through nozzles, momentum equation. Nozzle and diffuser efficiencies, mass flow rate through nozzle under isentropic flow condition, critical in nozzle flow, physical explanation of critical pressure for a given initial velocity under isentropic and actual flow conditions, general relationship, between area, velocity and pressure in nozzles and diffuser, design of nozzles and diffusers, supersaturated flow through nozzles, effect of variation of back pressure in nozzle.

**UNIT-III**

**Steam turbines- Principles** of working of steam turbines, classification comparison, and velocity diagram for impulse and reaction turbines. Velocity and pressure compounding, degree of reaction for reaction turbine, Power output, axial thrust diagram efficiency; energy lost by impulse and reaction turbines. Optimum value of blade-speed ration in impulse and reaction turbines, losses in steam turbines, state point locus and reheat factor, need of governing, throttle governing, nozzle governing and bypass governing speeder and anticipatory gear, governing of reheat turbines, direct digital control, governing characteristics, steam turbine auxiliary systems.

**UNIT-IV**

**Boilers-** Purpose, Classification of boilers, Fire tube and water tube boilers, Mountings and accessories, description of Lancashire, Locomotive, Babcock Wilcox boilers, boiler performance, draught, design of natural draught chimney, artificial draught, mechanical draught, efficiency of boiler and heat balance, safety devices, natural, forced, induced and balanced drafts.

**UNIT-V**

**Condensers and Cooling Towers-** Function of condenser, condensing system, surface and jet condensers, mass of circulating water, condenser and vacuum efficiency, Cooling tower: construction details and analysis.

**One Dimensional Gas Dynamics-** Speed of sound, adiabatic and isentropic steady flows, Mach number, Mach angle, Area velocity relationship, normal shock wave, flow through converging diverging nozzle. Jet propulsion, turbo jet, rams' jet, turbo- prop.

**Syllabus (Practical):**

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

**Textbook(s):**


1. R. Yadav "Thermodynamics and Heat Engines" Central Publishing House.
2. V.P. Vasandani and D.S. Kumar "Heat Engineering" Metropolitan Book Co. Pvt. Ltd.
3. M.L. Mathur and Sharma "I.C. Engines" Dhanpat Rai & Sons.
4. P.L. Balaney "Thermal Engineering" Khanna Publisher.

**Reference Book(s):**

1. S.M. Yahya “Turbines, Compressors and Fans”
2. M.M. El-wakil “Power Plant Technology” McGraw Hill
3. Domkundwar and Arora” Power Plant Engineering” Dhanpat Rai and Sons.
4. K.W. Li and B. P. Priddy “Power Plant System Design” John Wiley

**Web link:**

1. https://www.youtube.com/watch?v=6JwhQtw3JFg&list=PLFD532699BF29580A
2. https://www.youtube.com/watch?v=6JwhQtw3JFg&list=PL96C465B858866CA2
3. https://www.coursebuffet.com/course/551/coursera/introduction-to-thermodynamics-transferring-energy-from-here-to-there-univ-of-michigan
4. https://www.coursebuffet.com/course/191/saylor/thermodynamics
5. https://www.coursebuffet.com/course/1509/edx/thermodynamics-iit-bombay
6. https://www.edx.org/course/thermodynamics-iitbombayx-me209-1x-1

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME504 | Design of Machine Elements -I | 3 | 0 | 2 | 0 | 4 |

| Evaluation Scheme (Theory) | | | | | Evaluation Scheme (Practical) | | | |
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**The ratio of weightage between Theory and Practical content will be 60%: 40%

**Syllabus (Theory):**

**Design Philosophy-** Problem identification- problem statement, specifications, constraints, Feasibility study technical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of best possible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.

**Selection of Materials-** Classification of Engg. Materials, Mechanical properties of the commonly used engg. Materials, hardness, strength parameters with reference to stress-strain diagram, Factor of safety.

**Mechanical Joints-** ISO Metric Screw Threads, Bolted joints in tension, eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.

**Riveted Joints, Cotter & Knuckle Joints-** Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

**Belt rope and chain drives-** Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, design of chain drives with sprockets.

**Keys, Couplings & Flywheel-** Design of Keys – Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

**Clutches-** Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

**Brakes-** Various types of Brakes, Self-energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

**Syllabus (Practical):**

1. Selection of material & IS coding
2. Selecting fit & assigning tolerances
3. Examples of Production considerations.

**Problems on**

1. Knuckle & Cotter joints
2. Torque: Keyed joints & shaft couplings
3. Design of screw fastening
4. Bending: Beams, Levers etc.
5. Combined stresses: Shafts, brackets, eccentric loading.
6. Design for rigidity (Transverse / Torsional)

**Text Book(s):**


1. Joseph Edward Shigley "Mechanical Engg. Design" Mc Graw Hill Book Co.
2. V.B. Bhandari "Design of Machine Elements" Tata McGraw Hill, New Delhi
3. PSG College of Engg "PSG Design Data Book" PSG Publication


**Reference Book(s):**


1. George Dieter "Engineering design" McGraw Hill, New York.
2. A.K. Chitale and R.C. Gupta "Product Design and Manufacturing" PHI, New Delhi.
3. Robert L. Norton "Machine Design An Integrated Approach" Addison Wisley Longman
4. S.G. Kulkarni "Machine Design" TMH, New Delhi.


**Web Link:**

1. https://www.youtube.com/watch?v=mzWMdZZaHwI&list=PL3D4EECEFAA99D9BE
2. https://www.mooc-list.com/course/machine-design-part-i-coursera
3. https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/#

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME507 | Theory of Machines | 3 | 1 | 2 | 0 | 5 |

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

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

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

**Course Syllabi (Theory):**

Kinematic pairs, chain, Mechanism, Machine, Structure, links, constrained motions, Types of joints, Inversions of Four-bar chain, Single and double slider crank chain, Quick return mechanisms.

Velocity determination; Relative velocity methods, Instantaneous center method, Kennedy's Theorem. Centripetal and tangential accelerations, Acceleration determination by graphical method, Coriolis component of acceleration, Klein's construction. Analytical methods to find velocity and acceleration of four link mechanism, slider crank mechanism.

Types of cams and followers, various motions of the follower, Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat –faced followers.

Open and crossed belt drives, velocity ratio, slip, material for belts, length of belts, ratio of tensions, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drive, chain length, classification of chains.

Gyroscope, Gyroscopic couple and its effect, pinching and rolling, Stability of an automobile (2-wheeeers).

Types of gears, terminology, condition for correct gearing, pressure angle, path of contact, arc of contact, Interference, undercutting, minimum number of teeth, number of pairs of teeth in contact, helical, worm gear, bevel gear. Gear trains; simple, compound, reverted and epicyclical, Solution of gear trains, sun and planet gear, differential of automobile.

Types of governors- watt, Porter, Proell, spring loaded centrifugal, Inertia, Sensitiveness, Stability, Isochronism's, Hunting, Effort and power of governor, controlling force, Static and dynamic balancing of rotating parts

**Course Syllabi (Practical):**

1. Governor apparatus
2. Gyroscope apparatus
3. Static and dynamic balancing machine
4. Balancing of reciprocating masses
5. Journal bearing apparatus
6. Universal vibration apparatus
7. Whirling of shaft apparatus
8. Various commonly used mechanisms and its inversions in machines
9. Standard rotor kit with crank shaft simulator
10. Lower and higher pairs
11. CAM and Follower

**Textbook:**


1. S. S. Rattan "Theory of machines" Tata McGraw Hill Publications.
2. Jagdish Lal "Theory of Mechanism and Machines" Metropolitan Book Co.
3. P.L. Ballaney "Theory of Machines" Khanna Publisher.


**Reference Books:**


1. A.H. Soni, "Mechanism synthesis and analysis" McGraw Hill Publication
2. P. Black "Mechanics of Machines" Pergamon Press.


**Web Link:**

1. https://www.youtube.com/watch?v=6coD3oOuhr8
2. https://www.youtube.com/watch?v=7eFYthZ0oRg&list=PLkUEX3IbW7lcSeN7pB1E3qDIx_KUKWKLP
3. https://www.mccormick.northwestern.edu/mechanical/courses/descriptions/314-theory-of-machines-dynamics.html

<table>
<tr><th rowspan="2" colspan="3">Course code</th><th rowspan="2" colspan="2">Course Title</th><th colspan="6">Teaching Scheme</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th colspan="2">S</th><th>Credits</th></tr>
<tr><td colspan="3">Open Elective-1<br>ME602</td><td colspan="2">Refrigeration & Air Conditioning</td><td>3</td><td>0</td><td>2</td><td colspan="2">0</td><td>4</td></tr>
<tr><th colspan="5">Evaluation Scheme (Theory)</th><th colspan="6">Evaluation Scheme (Practical)</th></tr>
<tr><th>Mid Term Test - I</th><th>Mid Term Test –II</th><th>End Term Test</th><th>Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks</th><th>Mid Term Test - I</th><th>End Term Test</th><th colspan="3">Class Participation/ Additional Continuous Evaluation*</th><th>Total Marks</th></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>20</td><td>50</td><td colspan="3">30</td><td>100</td></tr>
</table>

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

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

**Introduction- Definition** of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants- Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants; Introduction to Cryogenics.

**Air Refrigeration System-** Carnot refrigeration cycle. Temperature Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Aircraft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

**Vapour Compression (VC) Refrigeration Systems-** (A) Simple Vapour Compression (VC) Refrigeration systems-Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

**Multistage Ref. Systems-** Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

**Other Refrigeration Systems-** (A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems. Steam Jet Refrigerating

System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

**Psychrometry of Air & Air Conditioning Processes-** Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

**Air-Conditioning Load Calculations-** Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

**Air Conditioning Systems with Controls & Accessories-** Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

**Refrigeration and Air Conditioning Equipment's** Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

**Syllabus (Practical):**

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
2. To Study the Mechanical heat pump and find its C.O.P.
3. To study the Air and Water heat pump and find its C.O.P.
4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
5. To study the various controls used in Refrigerating & Air Conditioning systems.
6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.
8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.
9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.
10. To study the chilling plant and its working cycle

**Textbook(s):**

1. R.C. Jordan and G.B. Priester "Refrigeration & Air conditioning" Prentice Hall of India.
2. C.P. Arora, "Refrigeration & Air conditioning" TMH, New Delhi

**Reference Book(s):**

1. W.F. Stocker and J.W. Jones "Refrigeration & Air conditioning" TMH, New Delhi.
2. Manohar Prasad "Refrigeration & Air conditioning" Wiley Estern limited, New Delhi.

**Web Link:**

1. https://www.youtube.com/watch?v=zqXgmVnI3L8&list=PLE2DA184A2E479885
2. https://onlinecourses.nptel.ac.in/noc16_me12/preview
3. http://www.i-know.com/refrigeration-training-courses.aspx

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| Open Elective-I ID504 | Finite Element Analysis | 3 | 0 | 0 | 0 | 3 |

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

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

**UNIT I: INTRODUCTION**

Introduction of FEA, Stress and equilibrium. Boundary conditions. General description, Comparison of FEM with other methods. Nodes and elements, Meshing, Shape functions

**UNIT II: ONE–DIMENSIONAL FINITE ELEMENT ANALYSIS**

Bar Elements, Spring, Stiffness Matrix, Truss, Beam, Frame Elements

**UNIT III: Two–DIMENSIONAL FINITE ELEMENT ANALYSIS**

Introduction, Element Load Vector, Analysis of Plane and Beam, Axisymmetric Problems

**UNIT IV: FINITE ELEMENT METHODS**

Introduction of FEM, Formulation, Governing Equations, Steady state analysis of finite element model, Finite element methods, Applications

**UNIT V: COMPUTER IMPLEMENTATION OF FEM**

Use of symmetry and anti-symmetry Conditions in reducing a problem, Computer Implementation, Storage Schemes, Applications of Boundary Conditions.

**Textbooks and Reference books:**


1. A. V. Hutton, Fundamentals of Finite Element Analysis, Mc Graw Hill, 2005.
2. Y. M. Desai, T.I. Eldho and A. H. Shah, Finite Element Method with Applications in Engineering, Pearson, 2011.
3. R. Dhanaraj and K. P. Nair, Finite Element Method, Oxford, 2015
4. P. Seshu, Textbook of Finite Element Analysis, PHI, 2004.

5. R. D. Cook, D. S. Malkus, M. E. Plesha and R. J. Witt. Concepts and Applications of Finite Element Analysis, Wiley, fourth edition.

**Web Resource(s):**

http://nptel.ac.in/courses/112106135/1

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME604 | Design of Machine Elements-II | 3 | 0 | 2 | 0 | 4 |

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

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

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

1. **Design for Production-** Ergonomics and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining.
2. **Variable Loading-** Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.
3. **Shafts-** Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.
4. **Springs-** Types of springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem. Design of Cylinder, Design of Piston, Design of Crank shaft, Design of connecting rod, Design of Crane Hook, Design of Flywheels
5. **Bearings-** design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of Lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.
6. **Gears-** Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth,

7. **Dynamic load on gear teeth**- Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

**Course Syllabi (Practical):**

1. Fatigue loading
2. Helical compression, tension and torsional springs design
3. Curved Beams
4. Preloaded bolts and bolts subjected to variable stresses
5. Belt, Rope and Chain drive system
6. Gear Design
7. Sliding contact bearing design
8. Anti-friction bearing selection

**Textbook(s):**


1. Joseph Edward Shigley "Mechanical Engg. Design" Mc Graw Hill Book Co.
2. V.B. Bhandari "Design of Machine Elements" Tata McGraw Hill, New Delhi
3. PSG College of Engg "PSG Design Data Book" PSG Publication


**Reference Book(s):**


1. George Dieter "Engineering design" McGraw Hill, New York.
2. A. K. Chitale and R. C. Gupta "Product Design and Manufacturing" PHI, New Delhi.
3. Robert L. Norton "Machine Design An Integrated Approach" Addison Wisely Longman
4. S.G. Kulkarni "Machine Design" TMH, New Delhi.


**Web Link:**
https://www.youtube.com/watch?v=C5ZPaCvoigw&list=PLA5C56D8447F78725
http://nptel.ac.in/courses/112105124/

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| ME607 | Production Technology -II | 3 | 0 | 2 | 0 | 4 |

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

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

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

**UNIT I**

**Theory of Metal Cutting-** Geometry of cutting tools, metal machining, chip formation, types of chips, force analysis, velocity relationship, stress and strain analysis, power and energy relationships, thermal aspects, dynamometers for turning and drilling. Evaluation of machinability, tool wear and tool life, cutting forces, surface finish, economies of metal machining and cutting fluids,

**UNIT II**

**Milling-** Milling machines, specifications, Types of milling operations, cutter-types with geometry, materials, milling machine accessories, dividing heads, simple, compound, differential and angular indexing and calculations for cutting of different types of gears. Gear cutting on milling machine and by generating methods viz, hobbing, shaping, and rack cutting, gear finishing by shaving and grinding.

**UNIT III**

**Grinding machines and grinding process-** Grinding wheel, Types nomenclature and their selection. Centerless grinding and job feeding arrangement, Dressing and truing of grinding wheels. Super finishing processes: Honing, lapping, super finishing, polishing and buffing.

Broaching operation, types of broaching machines and broaches design, broaching tools.

**UNIT IV**

**Metal Forming-** Overview of metal forming processes, classification, Formability limits, Non-uniformity and segregation in materials, Hot, Cold and Warm working of materials, Strain rates in metal forming, forging, rolling, extrusion, drawing processes.

**UNIT V**

**Sheet metal operations**- Press-working equipment and Operations, Shearing, Drawing, Spinning, Stretch Forming, Embossing, Squeezing, Swaging, Coining and Bending Operations, Calculation of Press Capacity.

## Syllabus (Practical):

1. Study of single point cutting tool geometry & grind the tool as per given tool geometry.
2. Study the milling machine, milling cutters, indexing heads and indexing methods.
3. Prepare a gear on milling machine.
4. Prepare a hexagonal / octagonal nut using indexing head on milling m/c and to cut BSW/METRIC internal threads on lathe.
5. To cut multi-start square / metric threads.
6. To cut external metric threads & to meet it with the nut
7. To prepare the job by eccentric turning on lathe machine.
8. To prepare a job on shaper from given MS rod.
9. Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
10. To prepare a job on surface grinder/cylindrical grinder and measure the various parameters of the finished piece.
11. Disassembly and assembly of small assemblies such as tail stock, bench vice, screw jack
12. Multi slot cutting on milling machine by indexing.
13. Drilling and boring of a bush

## Textbooks:

1. P. N. Rao "Manufacturing Technology: Foundry, Forming and Welding" TMH.
2. James S. Campbell "Principles of Manufacturing Materials and Processes" TMH.

## Reference Books:

1.Cook "Manufacturing analysis" Addison-Wesley

2. Shaw "Metal cutting principles" MIT Press
Cambridge
3.R. K. Jain "Sen and Bhattacharya "Principles of metal cutting" New Central Book.
4."Manufacturing Engineering Technology" Pearson Education
5.P.C. Pandey and C.K. Singh "Production Engineering Sciences" Standard Publishers Ltd.
6.A. Ghosh and A.K. Mallick "Manufacturing Science" Wiley Eastern
7. ASTME "Fundamentals of Tool Design"

**WebLink:**

https://www.youtube.com/watch?v=AOdTvf_Q8BA&list=PL82E9A8429ED7BB27
https://www.youtube.com/watch?v=uEElKJf48_I&list=PL_jWpT554AQ6woY-6spPsNUP2Ew3edAwv&index=3
https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/

<table>
<tr><td colspan="3">Course Title and Code:<br>Department Elective-1<br>Automobile Engineering ME624</td></tr>
<tr><td colspan="2">Hours per Week</td><td>L-T-P: 3-0-2</td></tr>
<tr><td colspan="2">Credits</td><td>4</td></tr>
<tr><td colspan="2">Students who can take</td><td>B. Tech Semester-VI (Batch: 2016-20)/ Elective</td></tr>
<tr><td colspan="3">Course Objective:<br>To describe the functioning of the engine and its accessories, like gear box, clutch, brakes, steering, axles and wheels, Suspension, frame, springs and other parts. To perform test on petrol and diesel engines.</td></tr>
<tr><td colspan="3">On successful completion of this course, the students will be able to:<br>1. Explain the working of various parts like engine, transmission, clutch, Gear boxes, Differential axle, brakes.<br>2. Judge firing order for multi-cylinder engines for igniting of fuels.<br>3. Consider the environmental implications while choosing the material for fabrication of auto parts.<br>4. Describe how the suspension and steering systems operate.<br>5. Test the single cylinder/multi cylinder engine to find out the brake power developed and efficiency of the engine.<br>6. Calculate the Indicated Horsepower of each cylinder in a multi cylinder petrol engine.<br>7. Design the Spring used in suspension system of an automobile using the standardized materials and dimensions.<br>8. Design the connecting rod, most stressed part, of Internal Combustion Engine using the standardized materials and dimensions.<br>9. Develop Transmission train of a four-wheeler vehicle.<br>10. Tune the engines for controlling the emissions and maximizing the fuel efficiency.<br>11. Develop a strong base for understanding future developments in the automobile industry maintaining the sustainability.</td></tr>
<tr><td colspan="2">Prerequisites</td><td>Thermal Engineering, Fluid Mechanics, Heat Transfer</td></tr>
<tr><td>Sr. No.</td><td>Evaluation Component</td><td>Marks</td></tr>
<tr><td>1</td><td>Attendance</td><td>5</td></tr>
<tr><td>2</td><td>Assignment</td><td>10</td></tr>
<tr><td>3</td><td>Class Participation</td><td>Nil</td></tr>
<tr><td>4</td><td>Quiz</td><td>5</td></tr>
<tr><td>5</td><td>Theory Exam-I</td><td>10</td></tr>
<tr><td>6</td><td>Theory Exam-II</td><td>NIL</td></tr>
</table>

| | | |
|---|---|---|
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | Nil |
| 9 | Report-II | Nil |
| 10 | Report-III | Nil |
| 11 | Project-I | 20 |
| 12 | Project-II | Nil |
| 13 | Project-III | Nil |
| 14 | Lab Evaluation-I | Nil |
| 15 | Lab Evaluation-II | 20 |
| 16 | Course Portfolio | Nil |
| **Total (100)** | | 100 |

**Course Syllabi (Theory):**

1. Frame and Body: Layout of chassis, types of chassis frames and bodies.
2. Power Transmission: Clutch, gear box, propeller shaft, rear wheel drive, front wheel drive, 4-wheel drive, differential.
3. Types of automobile engines: Engine construction, turbo charging and super charging.
4. Engine lubrication: splash and pressure lubrication systems, oil filters, oil pumps.
5. Steering and suspension system: steering gear boxes, steering mechanism, suspension spring, shock absorber.
6. Braking system: Mechanical, hydraulic, air brakes, brake shoes and lining materials.
7. Cooling systems: air cooling, water cooling, water jackets around the cylinders.
8. Ignition System: Magneto and coil ignition systems.
9. Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, b.m.e.p. and i.m.e.p., volumetric efficiency; BSFC, ISFC, thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves.
10. Automotive Electrical System: Battery charging system, Wiring systems, electrical instruments, head lamp, electric horn, and fuel level indicator.
11. Automotive Air Conditioning: Introduction, loads, air conditioning system components, refrigerants, fault diagnosis.
12. Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System).

**Syllabus (Practical):**

1. Understand functioning of complete Transmission system including differential, clutch plate etc.

2. Understand functioning of Suspension system and steering system in a car model.
3. To find the indicated horsepower (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test
4. Understand working of Ignition system, setting of contact breaker points and spark plug gap.
5. To prepare variable speed performance test of a single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
6. Understand cooling system, lubrication system, braking system in a car model.
7. Understand automotive electrical system and safety system.
8. Understand automotive Air conditioning system.

**<u>Textbooks:</u>**


1. R.P. Sharma, "*Automobile Engineering*", Dhanpat Rai & Sons, New Delhi.
2. V.M. Domkundwar, "*Automobile Engineering*", Dhanpat Rai & Co, New Delhi.
3. R.B. Gupta, "*Automobile Engineering*", Satya Prakashan, New Delhi.


**<u>Reference Books:</u>**


1. Heniz Heisler, "*Vehicle and Engine Technology*", Elsevier Publication.
2. Kohli P.L., "*Automobile Engineering*", Tata McGraw Hill, Volume 1 & 2.
3. Jain Asthana, "*Automobile Engineering*", McGraw Hill Education

| Course code | Course Title | Teaching Scheme | | | | |
|---|---|---|---|---|---|---|
| | | L | T | P | S | Credits |
| (Elective-I) ME526 | Industrial Engineering | 3 | 0 | 2 | 0 | 4 |

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

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

**UNIT I**

**Introduction:** Definition and scope of industrial engineering, Role of an industrial engineering

**Plant Layout and Material handling-** Necessity, plant Location Analysis, site selection process, cost economics, Plant Layout, classification of production, types of layout, design & development of a process layout, development a layout, Group Technology. Material handling: principles of material handling and material handling equipment.

**UNIT II**

**Method Study and Work Simplification-** basic concepts, productivity, Method Study: Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques,

**Principles of Motion Economy-** introduction, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design.

**UNIT III**

**Work Measurement-** Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances and standard time.

**Job Evaluation-** introduction, job rating, merit rating, financial benefits.

**Value Engineering-** introduction, concept of value engineering, phases/functions of value engineering studies, application of value engineering.

**UNIT IV**

**Scheduling-** Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V**

**Inventory control**- Inventory Control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder Procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**Textbooks:**

1. N G Nair "Production and Operations Management" Tata McGraw Hill, New Delhi
2. E. S. Buffa "Modern Production and Operation Management" Willey.
3. Martand Telsang "Industrial Engineering and Production Management" S. Chand and Company.
4. James. B. Dilworth "Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International edition.

**Reference Books:**

1. Samson Eilon "Elements of production planning and control" Universal Book Corpn.
2. Elwood S. Buffa, and Rakesh K. Sarin "Modern Production / Operations Management" John Wiley and Sons
3. Kanishka Bedi "Production and Operations management" Oxford university press,
4. Melynk, Denzler "Operations management – A value driven approach" Irwin McGraw-Hill.
5. Norman Gaither, G. Frazier, "operations management" Thomson learning.
6. K.C. Jain & L.N. Aggarwal "Production Planning Control and Industrial Management" Khanna Publishers
7. S.N. Chary "Theory and Problems in Production & Operations Management" Tata McGraw Hill,
8. Upendra Kachru "Production and operations management – Text and cases" Excel books

**Web Link:**

https://www.youtube.com/watch?v=yYIVumq6sVM&list=PL48735E5582F11BC7
http://freevideolectures.com/Course/2367/Industrial-Engineering

| Course code | Course Title | Teaching Scheme | | | |
|---|---|---|---|---|---|
| | | L | T | P | Credits |
| Elective-I (ME525) | **Production Planning and Control** | 3 | 0 | 2 | 4 |

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

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

**UNIT I**

**Introduction-** Objectives and benefits of planning and control - Functions of production control - Types of production - job - batch and continuous - Product development and design - Marketing aspect - Functional aspects - Operational aspect - Durability and dependability aspect aesthetic aspect. Profit consideration - Standardization, Simplification & specialization - Break even analysis.

**UNIT II**

**Work study-** Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

**UNIT III**

**Product planning and process planning-** Product Planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multiproduct system.

**UNIT IV**

**Production scheduling-** Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual Loading-Basic scheduling problems

- Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control Systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

## UNIT V

**Inventory control and recent trends in ppc**- Inventory Control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder Procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

## Textbooks:


1. Martand Telsang "Industrial Engineering and Production Management" S. Chand and Company
2. James. B. Dilworth "Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International


## Reference Books:


1. Samson Eilon "Elements of production planning and control" Universal Book Corpn
2. Elwood S. Buffa, and Rakesh K.Sarin "Modern Production / Operations Management" John Wiley and Sons
3. Kanishka Bedi "Production and Operations management" Oxford university press
4. Melynk, Denzler "Operations management – A value driven approach" Irwin McGraw-Hill.
5. Norman Gaither, G. Frazier "operations management" Thomson learning
6. K.C. Jain & L.N. Aggarwal "Production Planning Control and Industrial Management" Khanna Publishers
7. S.N. Chary "Theory and Problems in Production & Operations Management" Tata McGraw Hill
8. Upendra Kachru "Production and operations management – Text and cases" Excel books


## Web Link:

https://www.youtube.com/watch?v=yYIVumq6sVM&list=PLE11DDCE5A7D834BD

<table>
<tr><td rowspan="2">Course code</td><td rowspan="2" colspan="4">Course Title</td><td colspan="5">Teaching Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>(Elective-I) ME521</td><td colspan="4">Product Design & Development</td><td>3</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
</table>

<table>
<tr><td colspan="5">Evaluation Scheme (Theory)</td><td colspan="4">Evaluation Scheme (Practical)</td></tr>
<tr><td>Mid Term Test - I</td><td>Mid Term Test - II</td><td>End Term Test</td><td>Class Participation Additional Continuous Evaluation*</td><td>Total Marks</td><td>Mid Term Test - I</td><td>End Term Test</td><td>Class Participation Additional Continuous Evaluation*</td><td>Total Marks</td></tr>
<tr><td>20</td><td>20</td><td>50</td><td>10</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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

**Introduction-** Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, Product Planning and Project Selection: Identifying opportunities, evaluate and prioritize projects, allocation of resources.

**Identifying Customer Needs- Interpret** raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs,

**Product Specifications-** Establish target specifications, setting final specifications,

**Concept Generation:** Activities of concept generation, clarifying problem, search both internally and externally, explore the output, Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, Concept Selection: Overview, concept screening and concept scoring, methods of selection.

**Theory of inventive problem solving (TRIZ)-** Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response, Intellectual Property: Elements and outline, patenting procedures., claim procedure, Design for Environment: Impact, regulations from government, ISO system.

**Textbooks:**

1. Ulrich K. T, and Eppinger S.D "Product Design and Development" Tata McGraw Hill
2. Otto K, and Wood K "Product Design" Pearson

**Reference books:**

1. Semyon D. Savransky "Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving" CRC Press.
2. Michael A. Orloff "Inventive thinking through TRIZ: a practical guide" Springer.
3. John Terninko, Alla Zusman "Systematic innovation: an introduction to TRIZ; (theory of inventive Problem Solving)" CRC Press.

**Web Link:**

https://www.youtube.com/watch?v=5OQAD606Yow
https://www.youtube.com/watch?v=5OQAD606Yow&list=PL48735E5582F11BC7
https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/
https://www.edx.org/course/product-design-delft-design-approach-delftx-dda691x-1
https://www.mooc-list.com/course/dda691x-delft-design-approach-edx?static=true

## CS2404: Machine Learning

| Course Title and Code: Machine Learning, CS2404 | |
|---|---|
| **Hours per Week** | **Curated MOOC** |
| Credits | **4** |
| Students who can take | **Pre-Ph.D, Post Graduate, Under graduate** |

**Course Objective:** With the increased availability of data from varied sources there has been increasing attention paid to the various data driven discipline such as analytics and machine learning. This course introduces concepts of machine learning from a mathematically well motivated perspective. Different learning paradigms and some of the more popular algorithms and architectures used in each of these paradigms would be covered in the course.

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

6. Identify machine learning techniques suitable for a given problem.
7. Interpret fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
8. Apply dimensionality reduction techniques.
9. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
10. Apply Suitable Machine Learning Technique.
11. Build Neural Network for Prediction
12. Utilize Reinforcement Learning concepts to improvise precision of models.

**erequisites: Linear Algebra, Basic Statistics, Programming Language**

**aluation Scheme**

| **Sr. No** | **Specifications** | **Marks** |
|---|---|---|
| 1 | Attendance | Nil |
| 2 | Assignment | 40 |
| 3 | Class Participation | Nil |
| 4 | Quiz | Nil |
| 5 | Theory Exam I | Nil |
| 6 | Theory Exam | 15 |
| 7 | Theory Exam (End Term) | 25 |
| 8 | Report-1 | Nil |
| 9 | Report-2 | Nil |
| 10 | Report-3 | Nil |
| 11 | Project -1 | Nil |
| 12 | Project -2 | Nil |
| 13 | Project -3 | Nil |
| 14 | Lab Evaluation1 | 10 |
| 15 | Lab Evaluation2 | 10 |
| 16 | Course portfolio | Nil |
| | **Total (100)** | **100** |

**Retest**

| | | |
|---|---|---|
| 1 | Theory Exam | 25 |
| 2 | Lab Evaluation | 10 |

**Course Contents:**

Probability Theory, Linear Algebra, Convex Optimization - (Recap), Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance

Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component, Partial Least squares

Linear Classification, Logistic Regression, Linear Discriminant Analysis, Perceptron, Support Vector Machines

Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures

Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation

Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Gaussian Mixture Models, Expectation Maximization, Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods,
Applications)

**Suggested Reading Materials:**

**The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman (freely available online)**

**Pattern Recognition and Machine Learning, by Christopher Bishop**

This course would be delivered on SWAYAM from 27th January 2020 to 17th April 2020 by Prof. Balaraman Ravindran, Professor in Computer Science at IIT Madras and Mindtree Faculty Fellow Student may refer course notes, videos & ppts.

| | |
|---|---|
| Course Title and Course Code | **Computer Aided Product Design (ME1112)** |
| Hours per Week | **L T P: 2 0 4** |
| Credits | **4** |
| Students who can take | **B. Tech Semester-IV (Batch: 2016-2020)**<br>**B. Tech Semester-III (Batch: 2017-2021)** |

**Course Objective:**
This course aims to expose the students to the various aspects of Industrial Design so as to design new products considering aesthetics, cost, environment and other human factors.

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

1. Read, understand and analyze drawing sheet of parts and assemblies as per standards.
2. Develop 3D model of the parts as per the dimensional values.
3. Assemble number of 3D model of parts together to check for its dimensional suitability and compatibility for an assembly.
4. Generate the drafting sheet of assembled product with Bill of materials.

| **Prerequisites** | | **Basics of Physics** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | NIL |
| 2 | Assignment | 10 |
| 3 | Class Participation | 5 |
| 4 | Quiz | 5 |
| 5 | Theory Exam-I | NIL |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 20 |
| 8 | Report-I | NIL |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | NIL |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |

| | | |
|---|---|---|
| 14 | Lab Evaluation-I | 20 |
| 15 | Lab Evaluation-II | 20 |
| 16 | Course Portfolio | 20 |
| **Total (100)** | | **100** |

**Syllabus:**

Concept of product design, Limits and fits, Geometric dimensioning and tolerance (GD&T).

Introduction to CAD software, Sketch Module, drawing commands in 2D Sketch.

3D Modelling tools with example like Extrude, Revolve, Sweep, Blend.

Editing commands like fillet, chamfer, holes, drafts, pattern.

Advance 3D modelling tool Relation, Family table, UDF.

Top down and bottom up assembly approach, mechanism in assembly

Drafting, bill of materials, sheet metal.

CNC programming.

**Lab/ List of experiments:**

| | Week 1-2 | Week 3-5 | Week 6-8 | Week 9-10 | Week 11-12 |
|---|---|---|---|---|---|
| Month 1-3 | Interface with software<br>Sketcher<br>Module | 3D modelling<br><br>Components Design using Software | Assembly<br><br>Assembly of prepared parts and Mechanism | Drafting and Sheetmetal<br>Preparing Draft Sheets of assembly, and sheet metal job | Aesthetical Design<br>Prepare a aesthetical components and parts. |

**Textbooks:**

1. Prof. Sham Tickoo, “Creo Parametric 2.0 for Designers” CADCIM Technologies; 1$^{st}$ edition -2013.
2. Bruce A. Wilson, “GD&T: Application and Interpretation” Goodheart-Willcox Company, 5$^{th}$ edition -2010.
3. Mikell P. Groover Embory W. Zimmers, “CAD/CAM Computer aided design and manufacturing” Dorling Kindersley India Pvt. Ltd. Pearson Education, 2008

**<u>Reference books</u>**:

1. Gaurav Verma, Matt Weber, “Creo Parametric 5.0 Black Book “CADCAMCAE Works 3rd edition -2018.

Gene Cogorno, “Geometric Dimensioning and Tolerancing for Mechanical Design, A Self-Teaching Guide to ANSI Y 14.5M1982 and ASME Y 14.5M1994 Standards” Mcgraw-hill, 2006.

| | |
|---|---|
| Course Title and Course Code | **Element of Stress Analysis (ME1202)** |
| Hours per Week | **L T P: 3 0 2** |
| Credits | 4 |
| Students who can take | **B. Tech Semester-VII ME** |

**Course Objective:**

The key objective of this course is to acquaint the students with fundamentals of stress and strain for 1-D, 2-D, and 3-D systems, factors cause failure and theories to avoid failure, transducers to measure the strain and introduction to fracture mechanics.

**Learning Outcomes:**

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

5. Formulate the stress and strain present in any mechanical system.
6. Conduct the test to evaluate the behavior of stress and strain
7. Conduct experiment to determine 1-D, 2-D, and 3-D stress tensor in a specimen.
8. Determine stress and strain using analytical and graphical methods.
9. Identify use of transducers for the measurements of strain.
10. Analyze the crack propagation and fracture mechanics

| Sr. No | Specifications | Marks |
|---|---|---|
| 1 | Attendance | 5 |
| 2 | Assignment | 10 |
| 3 | Class Participation | NIL |
| 4 | Quiz | 5 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 30 |
| 8 | Report-I | NIL |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | NIL |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I (Continuous) | 25 |
| 15 | Lab Evaluation-II (Exam) | 15 |
| 16 | Course Portfolio | NIL |
| **Total (100)** | | **100** |

**<u>COURSE SYLLABUS (Theory):</u>**

**Unit I Simple Stresses, Strains & Compound Stresses**

Definition/derivation of normal stress, shear stress, and normal strain and shear strain –Stress-strain diagram-Elastic constants –Poisson's ratio –relationship between elastic constants and Poisson's ratio –Hook's law –Strain energy. Introduction to compound stresses, state of stress at a point, General two-dimensional stress system, Principal stresses, and principal planes. Mohr's circle of stresses and Theories of Failure.

**Unit II Three-Dimensional Stress and Strain Fields**

Introduction to cartesian tensors, Strains: concept of strain, derivation of small strain tensor and compatibility, stress: derivation of Cauchy relations and equilibrium and symmetry equations, airy stress function, plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

**Unit III Introduction to Material Modelling**

Constitutive equations: generalized Hooke's law, linear elasticity, material symmetry; boundary value problems: concepts of uniqueness and superposition, introduction to plasticity, elastic constitutive models and plastic models, finite element implementation of these models, thermo-elasticity, 2-d contact problems, computational implementation of theories of failure.

**Unit IV Stresses and Strain Measurements**

Introduction to strain measurement and related instrumentation strain gage-based transducers, Electric Resistance strain gauges, Calibration of strain gauges, Measuring circuits, arrangements of strain gauge elements (rosettes), Practical set-up for measurement of strains, introduction to optical methods in strain measurements, digital image correlation in dynamic/impact conditions.

**Unit V Generalized Problems**

Thick cylinder under uniform internal and / or external pressure, rotating disks of uniform thickness, solid disks, circular disk with a hole, stress concentration, introductory fracture mechanics, analysis of cracked bodies, numerical implementation of fracture mechanics.

**COURSE SYLLABUS (Practical):**

1. To evaluate stress strain curve for tension test on a standard Mild Steel specimen
2. To evaluate stress strain curve for compression test on a standard Mild Steel specimen and compare the result with the tension test.
3. To write a MATLAB program to generate LAME'S ellipsoid
4. To write a MATLAB program to generate principle stress, shear stress of a given element and plot the same.
5. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
6. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
7. To develop a CAD model in-order to conduct ANSYS analysis on a given specimen.
8. To study the behavior of stress and strain of a given specimen in ANSYS environment.
9. To study the behavior of deformation of a given specimen in ANSYS environment.
10. To perform Fatigue Test on a given specimen in ANSYS environment.

**Textbooks:**

1. Timoshenko, S and Goodier, J. N., "Theory of Elasticity", Tata McGraw Hill, New Delhi,3$^{rd}$ edition, 1970
2. Srinath, L. S., "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, 3$^{rd}$ edition, 2010
3. Thomas M. G., Ronald E. S., George. E. M, "Continuum Mechanics for Engineers", 3rdEdition, CRC Press, Boca Raton, 2009

**References:**

1. Batra, R. C., "Elements of Continuum Mechanics", Reston, 2006.
2. George E. M, Schaum's "Outline of Continuum Mechanics", McGraw-Hill, 1970
3. Dill, Ellis Harold, "Continuum Mechanics: Elasticity, Plasticity, Viscoelasticity", CRC Press, 2006.
4. Sadhu Singh," Theory of Elasticity" Khanna publisher, 4$^{th}$ edition, 2013
5. Timoshenko, Stephen P., and James M. G., "Theory of elastic stability", Courier Corporation, 2$^{nd}$ edition, 2009.

| | |
|---|---|
| Course Title and Course Code | **POWER PLANT ENGINEERING (ME1203)** |
| Hours per Week | **L T P: 3 0 2** |
| Credits | **4** |
| Students who can take | **B. Tech Semester-VII** |

**Course Objective:**
Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

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

11. Model and compare different boiler's based on high pressure or low pressure
12. Draw and construct different power plants based on the working fluid used (diesel, water, etc.)
13. Demonstrate various functions of different accessories of boilers
14. Critic what would be a sustainable power plant out of all different power plants studies
15. Analyze and solve energy and economic related issues in power sectors

| **Prerequisites** | | **Basics of Physics** |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | 5 |
| 2 | Assignment | 10 |
| 3 | Class Participation | NIL |
| 4 | Quiz | 5 |
| 5 | Theory Exam-I | 20 |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 40 |
| 8 | Report-I | NIL |
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | NIL |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| 16 | Course Portfolio | NIL |
| **Total (100)** | | **100** |

**COURSE SYLLABUS (Theory):**

**UNIT – I**

Introduction to power plants and Steam Power Plant: Conventional and Non-Conventional Energy Sources, Load-duration curves and definitions, selection of site for steam power plants, Boiler performance, Rankine cycle, Reheat cycle, Regenerative cycle, Surface condenser performance.

**UNIT – II**

Diesel Power Plant: Diesel engine performance and operation, Power and mechanical efficiency, m.e.p., s.f.c., volumetric efficiency, Thermal efficiency, relative efficiency, Heat balance.

**UNIT – III**

Gas Turbine Power Plant: Sterling Cycle, Ericson cycle, Brayton cycle, Advantages and Disadvantages of Gas Turbine Plant, Reheating, Regeneration, Intercooling

**UNIT – IV**

Solar Energy Power Plant: Solar constant, Solar energy collectors, Photovoltaic power system, solar thermal energy power plant, solar central receiver system, PV syst project design calculation.

**Other Power Plants and economics of power plants:** Geo-thermal power plant, OTEC power plant, Tidal wave power plant. Cost of Electric Energy - Fixed and operating Costs - Energy Rates - Types of Tariffs.

**COURSE SYLLABUS (Practical):**

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To find power output & efficiency of a steam turbine.
5. To find the condenser efficiencies.
6. To study and find volumetric efficiency of a reciprocating air compressor.
7. To conduct variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
8. PVsyst based designing of a solar PV cell project.

**Textbooks:**

1. Nag P.K., "Power plant Engineering", Tata McGraw-Hill, 2008.
2. R. Yadav, "Fundamentals of power plant engineering", Central Publishing House, Allahabad, 2011.

| | |
|---|---|
| Course Title and Course Code | **Internal Combustion Engines (ME1201)** |
| Hours per Week | **L T P: 3 0 2** |
| Credits | **4** |
| Students who can take | **B. Tech Semester-VII** |

**Course Objective:**

The main objective of the course is to give the students an introduction to reciprocating internal combustion engines with emphasis on marine and stationary applications. The focus is on explaining engine performance in terms of power, energy utilization and exhaust emissions, its relation to internal processes like combustion and gas exchange, and varying engine operating conditions.

**Learning Outcomes:**

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

16. Demonstrate different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
17. Analyze and compute various efficiencies of power cycle of internal combustion engines using ideal gas cycles, air cycles, and fuel-air cycles.
18. Demonstrate engine heat transfer and its relation to thermal loading of engine components and cooling.
19. Compute rate of heat release based on measured dynamic cylinder pressure.
20. Demonstrate homogeneous combustion in SI-engines and spray combustion in CI-engines. Fuel quality requirements of SI- and CI-engines.
21. Design the components of exhaust emissions and demonstrate the mechanisms of emission formation.
22. Design exhaust system, and their relations to fuel quality and engine performance.
23. Compute the kinematics of the crank mechanism and compute inertia forces and moments in single-

| | Prerequisites | Thermodynamics, Heat Transfer |
|---|---|---|
| **Sr. No** | **Specifications** | **Marks** |
| 1 | Attendance | 5 |
| 2 | Assignment | 20 |
| 3 | Class Participation | NIL |
| 4 | Quiz | 5 |
| 5 | Theory Exam-I | 10 |
| 6 | Theory Exam-II | NIL |
| 7 | Theory Exam-III | 40 |
| 8 | Report-I | NIL |

| | | |
|---|---|---|
| 9 | Report-II | NIL |
| 10 | Report-III | NIL |
| 11 | Project-I | NIL |
| 12 | Project-II | NIL |
| 13 | Project-III | NIL |
| 14 | Lab Evaluation-I | 10 |
| 15 | Lab Evaluation-II | 10 |
| 16 | Course Portfolio | NIL |
| **Total (100)** | | **100** |

**COURSE SYLLABUS (Theory):**

**UNIT - I**

**Air standard cycles:** Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems. **(8)**

**UNIT - II**

**Carburetion, fuel Injection and Ignition systems:** Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of injection systems; petrol injection, Requirements of ignition system; types of ignition systems, ignition timing; spark plug. **(4)**

**Combustion in S. I. Engines:** Ignition limits, Stages of combustion in SI engine, effect of engine variables on ignition lag, effect of engine variables on flame propagation, rate of pressure rise, abnormal combustion, detonation or knocking, effects of detonation. **(4)**

**Combustion in C. I. Engines:** Stages of combustion, air-fuel ratio in CI engines, delay period or ignition lag, variables affecting delay period, diesel knock, and methods of controlling diesel knock. **(2)**

**UNIT - III**

**Lubrication and Cooling Systems:** Lubrication principles, hydrodynamic lubrication, Functions of the lubricating system, Properties of the lubricating oil, SAE rating of lubricating oils, Service rating of oils, Types of lubrication systems; mist, wet sump and dry sump lubrication systems; engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators. **(6)**

**UNIT – 1V**

**Engine Testing and Performance:** Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; speed, fuel and air consumption, brake power, indicated power and friction power, heat going to cooling water and exhaust gases; performance curves. Problems.

**(8)**

**Air pollution from I.C. Engine and Its remedies:** Pollutants from S.I. and C.I. Engines, Mechanism of formation of pollutants in SI engines, Exhaust emission, emission of unburnt hydrocarbon. Mechanism of formation of pollutants in CI engines. Methods of emission control; alternative fuels for I.C. Engines. **(8)**

**<u>COURSE SYLLABUS (Practical):</u>**

11. To study the constructional details & working principles of two-stroke/ four stroke petrol engines.
12. To study the constructional detail & working of two-stroke/ four stroke diesel engines.
13. To draw valve timing diagram of two stroke/four stroke petrol and diesel engines.
14. To find the indicated horsepower (IHP) on multi-cylinder petrol engine by Morse Test.
15. To perform constant speed performance test on a single cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and (ii) bhp vs mep, mechanical efficiency & sfc.
16. To perform variable speed performance test of a single cylinder diesel engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
17. To perform constant speed performance test on a single cylinder petrol engine & draw curves of (i) bhp vs fuel rate, air rate and (ii) bhp vs mep, mechanical efficiency & sfc.
18. To perform variable speed performance test of a single cylinder petrol engine and prepare the curves (i) bhp, ihp, fhp, vs. speed (ii) volumetric efficiency & indicated specific fuel consumption vs. speed.
19. To prepare heat balance sheet on multi-cylinder petrol engine.
20. To prepare heat balance sheet on single cylinder diesel engine

**<u>Textbooks:</u>**


1. Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, 2nd Edition, Pearson Prentice Hall, 2004.
2. Internal Combustion Engines –V. Ganesan, Pub.- McGraw-Hill.
3. Internal combustion engines-- M. L. Mathur, R. P. Sharma, Dhanpat Rai Publications, 2014
4. Internal Combustion Engines and Air Pollution-- R. Yadav, Central Publishing House, Allahabad 2012
5. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York.