Pimpri Chinchwad Education Trust's

# PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

# DEPARTMENT OF MECHANICAL ENGINEERING

## Curriculum Structure and Syllabus

## of

## Final Year B Tech Mechanical Engineering

## Scheme – A/B/C

## (Regulation 2020)

## Effective from Academic Year 2024-25

## Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers .

## Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institue.
2. Imparting right Attitude, Skills, and Knowledge for self-sustenance through Quality Education.
3. Creating globally Competent and Sensible Engineers, Researchers and Entrepreneurs with an ability to think and act independently in demanding situations.

## EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

## Course Approval Summary

**A. Board of study -Department of Mechanical Engineering**

| Sr. No. | Course Name | Course Code | Page Number | Signature and Stamp of BoS Chairman |
|---|---|---|---|---|
| | **Final Year B Tech Semester VII – Scheme A** | | | |
| 1 | Mechanical Vibrations and Acoustics | BME7416 | 10 | |
| 2 | Mechanical Vibrations and Acoustics Lab | BME7417 | 12 | |
| 3 | Refrigeration & Air Conditioning | BME7418 | 13 | |
| 4 | Refrigeration & Air Conditioning lab | BME7419 | 15 | |
| 5 | **Professional Elective Course -V** | **BME7505** | | |
| | Computational Fluid Dynamics | BME7505A | 16 | |
| | Finite Element Analysis | BME7505B | 18 | |
| | Operation Research | BME7505C | 20 | |
| | Energy Storage & Management | BME7505D | 22 | |
| | Data Analytics for Mechanical Engineering | BME7505E | 24 | |
| 6 | **Professional Elective Course -VI** | **BME7506** | | |
| | Engineering Economics & Management | BME7506A | 26 | |
| | Reverse Engineering | BME7506B | 27 | |
| | Robotics & Automation | BME7506C | 28 | |
| | Steam Engineering & Energy Conservation | BME7506D | 30 | |
| | Adhesive Technologies | BME7506E | 32 | |
| | **Final Year B Tech Semester VIII – Scheme A** | | | |
| 7 | Project | BME8701 | 61 | |
| 8 | Internship | BME8801 | 63 | |

**B) Board of study -Department of Information Technology**

| Sr. No. | Course Name | Course Code | Page Number | Signature and stamp of BoS |
|---|---|---|---|---|
| 1 | Cloud Computing | BIT7601 | 35 | |
| 2 | Data Science for Engineers | BIT7602 | 36 | |

**C) Board of study-Department of Computer Engineering**

| Sr. No. | Course Name | Course Code | Page Number | Signature and stamp of BoS Chairman |
|---|---|---|---|---|
| 1 | Web Technology and its Applications | BCE7607 | 38 | |
| 2 | Software Testing & Quality Assurance | BCE7608 | 40 | |
| 3 | MOOC Course | BCE7609 | 41 | |
| 4 | Database Management System | BCE7610 | 42 | |
| 5 | Introduction to Blockchain | BCE7611 | 43 | |
| 6 | Android App Development with Kotlin | BCE7612 | 44 | |
| 7 | Agile Project Management | BCE7613 | 45 | |

**D) Board of study -Department of Civil Engineering**

| Sr. No. | Course Name | Course Code | Page Number | Signature and stamp of BoS Chairman |
|---|---|---|---|---|
| 1 | E- Waste Management | BCI7605A | 47 | |
| 2 | Advanced Instrumentation in Infrastructural Engineering | BCI7605B | 49 | |
| 3 | MOOC (only for civil department student) | BCI7605C | - | |
| 4 | 3-D printing technique for construction | BCI7606A | 51 | |
| 5 | Structural Health Monitoring and Audit | BCI7606B | 53 | |

**E) Board of study- Department of Electronic and Telecommunication**

| Sr. No. | Course Name | Course Code | Page Number | Signature and stamp of BoS |
|---|---|---|---|---|
| 1 | Bio- Inspired Systems And Computing | BET7601 | 54 | |
| 2 | Sensor and Automation with IoT | BET7602 | 55 | |
| 3 | MOOC | BET7603 | 57 | |
| 4 | Drone Technology. | BET7604 | 58 | |
| 5 | Advanced Driver Assistance System(ADAS) | BET7605 | 59 | |

**Approved by Academic Council:**

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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# LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

| Sr. No. | Abbreviation | Type of Course |
|---|---|---|
| 1. | BSC | Basic Science Course |
| 2. | ECC | Engineering Core/ Science Course |
| 3. | HSMC | Humanities, Social Sciences and Management Course |
| 4. | PCC | Programme / Professional Core Course |
| 5. | PEC | Programme / Professional Elective Course |
| 6. | OEC | Open Elective Course |
| 7. | PROJ | Project |
| 8. | INTR | Internship |
| 9. | AC | Audit Course |
| 10. | MC | Mandatory Course |
| 11. | LS | Life Skill |
| 12. | PFC | Proficiency Course |
| 13. | MO | MOOC Course |
| 14. | L | Lecture |
| 15. | P | Practical |
| 16. | T | Tutorial |
| 17. | H | Hours |
| 18. | CR | Credits |
| 19. | IE | Internal Evaluation |
| 20. | MTE | Mid Term Evaluation |
| 21. | ETE | End Term Evaluation |
| 22. | TW | Term Work |
| 23. | OR | Oral |
| 24. | PR | Practical |

# CURRICULUM FRAMEWORK
# (2020-2021; 2021-2022; 2022-2023; 2023-2024)

## The Course and Credit Distribution

| Sr. No. | Type of Courses | No of Courses | Total Credits No |
|---|---|---|---|
| **1.** | Basic Science Course (BSC) | 8 | 23 |
| **2.** | Engineering Core/ Science Course (ECC) | 13 | 22 |
| **3.** | Humanities, Social Sciences And Management Course (HSMC) | 6 | 13 |
| **4.** | Professional Core Course (PCC) | 17 | 48 |
| **5.** | Professional Elective Course (PEC) | 6 | 18 |
| **6.** | Open Elective Course (OEC) | 6 | 18 |
| **7.** | Project (PROJ) | 2 | 16 |
| **8.** | Internship (INTR) | 1 | 3 |
| **9.** | Audit Course (Audit) | 3 | - |
| **10.** | Mandatory Course (MC) | 2 | - |
| **11.** | Life Skill (LS) | 4 | - |
| **12.** | Proficiency Course (PFC) | 4 | - |
| | **Total** | **72** | **161** |

| COURSE DISTRIBUTION : SEMESTER WISE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sr. No. | Type of Course | No of Courses/ Semester | | | | | | | Total |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1. | Basic Science Course (BSC) | 3 | 3 | 2 | - | - | - | - | - | 8 |
| 2. | Engineering Core Course (ECC) | 6 | 5 | 1 | 1 | - | - | - | - | 13 |
| 3. | Humanities, Social Sciences And Management Course (HSMC) | 1 | 1 | 1 | 1 | 1 | 1 | - | - | 6 |
| 4. | Professional Core Course (PCC) | - | - | 5 | 4 | 3 | 3 | 2 | - | 17 |
| 5. | Professional Elective Course (PEC) | - | - | - | - | 2 | 2 | 2 | - | 6 |
| 6. | Open Elective Course (OEC) | - | - | - | 1 | 1 | 2 | 2 | - | 6 |
| 7. | Project (PROJ) | - | 1 | - | - | - | - | - | 1 | 2 |
| 8. | Internship (INTR) | - | - | - | - | - | - | - | 1 | 1 |
| 9. | Audit Course (Audit) | - | - | - | 1 | 1 | 1 | - | - | 3 |
| 10. | Mandatory Course (MC) | - | - | - | - | 1 | 1 | - | - | 2 |
| 11. | Life Skill (LS) | 1 | 1 | 1 | 1 | - | - | - | - | 4 |
| 12. | Proficiency Course (PFC) | - | - | 1 | 1 | 1 | 1 | - | - | 4 |
| **Total** | | **11** | **11** | **11** | **10** | **10** | **11** | **6** | **2** | **72** |

| CREDIT DISTRIBUTION : SEMESTER WISE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Lecture hour = 1 Credit 2 Lab Hours = 1 Credit 1 Tutorial Hour = 1 Credit | | | | | | | | | | |
| Sr. No. | Type of Courses | No of Credits /Semester | | | | | | | | Total |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1. | Basic Science Course (BSC) | 9 | 9 | 5 | - | - | - | - | - | 23 |
| 2. | Engineering Core Course (ECC) | 9 | 7 | 3 | 3 | - | - | - | - | 22 |
| 3. | Humanities, Social Sciences And Management Course (HSMC) | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 13 |
| 4. | Professional Core Course (PCC) | - | - | 11 | 12 | 9 | 8 | 8 | - | 48 |
| 5. | Professional Elective Course (PEC) | - | - | - | - | 6 | 6 | 6 | - | 18 |
| 6. | Open Elective Course (OEC) | - | - | - | 3 | 3 | 6 | 6 | - | 18 |
| 7. | Project (PROJ) | - | 2 | - | - | - | - | - | 14 | 16 |
| 8. | Internship (INTR) | - | - | - | - | - | - | - | 3 | 3 |
| 9. | Audit Course (Audit) | - | - | - | - | - | - | - | - | - |
| 10. | Mandatory Course (MC) | - | - | - | - | - | - | - | - | - |
| 11. | Life Skill (LS) | - | - | - | - | - | - | - | - | - |
| 12. | Proficiency Course (PFC) | - | - | - | - | - | - | - | - | - |
| **Total** | | **20** | **20** | **22** | **20** | **20** | **22** | **20** | **17** | **161** |

# Curriculum Structure

## Final Year B Tech – Scheme A/B/C

## Mechanical Engineering

## CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING

### SEMESTER – VII (Scheme – A)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | H | CR | FA | SA | TW | PR | OR | Total |
| BME7416 | PCC | Mechanical Vibrations and Acoustics | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7417 | PCC | Mechanical Vibrations and Acoustics Lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME7418 | PCC | Refrigeration & Air Conditioning | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7419 | PCC | Refrigeration & Air Conditioning lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME7505 | PEC | Professional Elective Course –V | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7506 | PEC | Professional Elective Course -VI | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7605 | OEC | Open Elective Course –V | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7606 | OEC | Open Elective Course -VI | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| **TOTAL** | | | **18** | **--** | **4** | **22** | **20** | **240** | **360** | **50** | **-** | **100** | **750** |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*

# Professional Elective Courses

| Code | Professional Elective Course – V (BME7505) | |
|---|---|---|
| **BME7505A** | Computational Fluid Dynamics | Choose any one |
| **BME7505B** | Finite Element Analysis | |
| **BME7505C** | Operation Research | |
| **BME7505D** | Energy Storage & Management | |
| **BME7505E** | Data Analytics for Mechanical Engineering | |

| Code | Professional Elective Course – VI (BME7506) | |
|---|---|---|
| **BME7506A** | Engineering Economics & Management | Choose any one |
| **BME7506B** | Reverse Engineering | |
| **BME7506C** | Robotics & Automation | |
| **BME7506D** | Steam Engineering & Energy Conservation | |
| **BME7506E** | Adhesive Technologies | |
| **BME7506F** | Electric, autonomous and connected vehicle technology-II | |

# Open Elective Courses

## Semester-VII

### Offered by Department of Information Technology

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BIT7601** | Cloud Computing | - |
| VI | **BIT7602** | Data Science for Engineers | |

### Offered by Department of Computer Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCE7607** | Web Technology and its Applications | Choose any one |
| | **BCE7608** | Software Testing & Quality Assurance | |
| | **BCE7609** | MOOC Course | |
| VI | **BCE7610** | Database Management System | |
| | **BCE7611** | Introduction to Block chain | |
| | **BCE7612** | Android App Development with Kotlin | |
| | **BCE7613** | Agile Project Management | |

### Offered by Department of Civil Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCI7605A** | E- Waste Management | Choose any one |
| | **BCI7605B** | Advanced Instrumentation in Infrastructural Engineering | |
| | **BCI7605C** | MOOC (only for civil department student) | |
| VI | **BCI7606A** | 3-D Printing Technique for Construction | |
| | **BCI7606B** | Structural Health Monitoring and Audit | |

### Offered by Department of Electronics & Telecommunication Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BET7601** | Bio- Inspired Systems And Computing | Choose any one |
| | **BET7602** | Sensor and Automation using IoT | |
| | **BET7603** | MOOC | |
| VI | **BET7604** | Drone Technology. | |
| | **BET7605** | Advanced Driver Assistance System(ADAS) | |

## CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING

## SEMESTER – VIII (Scheme – A)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | H | CR | FA | SA | TW | PR | OR | Total |
| BME8701 | PROJ | Project | - | 28 | - | 28 | 14 | - | - | 200 | - | 150 | 350 |
| BME8801 | INTR | Internship | - | - | - | - | 3 | - | - | 100 | - | - | 100 |
| **TOTAL** | | | -- | 28 | -- | 28 | 17 | -- | - | 300 | - | 150 | 450 |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*

## CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING

### SEMESTER – VII (Scheme – B)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | H | CR | FA | SA | TW | PR | OR | Total |
| BME7701 | PROJ | Project | - | 28 | - | 28 | 14 | - | - | 200 | - | 150 | 350 |
| BME7801 | INTR | Internship | - | - | - | - | 3 | - | - | 100 | - | - | 100 |
| **TOTAL** | | | -- | 28 | -- | 28 | 17 | -- | - | 300 | - | 150 | 450 |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*

**CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING**

## SEMESTER – VIII (Scheme – B)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | H | CR | FA | SA | TW | PR | OR | Total |
| BME8416 | PCC | Mechanical Vibrations and Acoustics | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME8417 | PCC | Mechanical Vibrations and Acoustics Lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME8418 | PCC | Refrigeration & Air Conditioning | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME8419 | PCC | Refrigeration & Air Conditioning lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME8505 | PEC | Professional Elective Course –V | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME8506 | PEC | Professional Elective Course -VI | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME8605 | OEC | Open Elective Course –V | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME8606 | OEC | Open Elective Course -VI | 3 | -- | -- | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| **TOTAL** | | | **18** | **--** | **4** | **22** | **20** | **240** | **360** | **50** | **-** | **100** | **750** |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*

# Professional Elective Courses

| Code | Professional Elective Course – V (BME7505) | |
|---|---|---|
| **BME8505A** | Computational Fluid Dynamics | Choose any one |
| **BME8505B** | Finite Element Analysis | |
| **BME8505C** | Operation Research | |
| **BME8505D** | Energy Storage & Management | |
| **BME8505E** | Data Analytics for Mechanical Engineering | |

| Code | Professional Elective Course – VI (BME7506) | |
|---|---|---|
| **BME8506A** | Engineering Economics & Management | Choose any one |
| **BME8506B** | Reverse Engineering | |
| **BME8506C** | Robotics & Automation | |
| **BME8506D** | Steam Engineering & Energy Conservation | |
| **BME8506E** | Adhesive Technologies | |
| **BME8506F** | Electric, autonomous and connected vehicle technology-II | |

# Open Elective Courses

## Semester-VII

### Offered by Department of Information Technology

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BIT8601** | Cloud Computing | - |
| VI | **BIT8602** | Data Science for Engineers | |

### Offered by Department of Computer Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCE8607** | Web Technology and its Applications | Choose any one |
| | **BCE8608** | Software Testing & Quality Assurance | |
| | **BCE8609** | MOOC Course | |
| VI | **BCE8610** | Database Management System | |
| | **BCE8611** | Introduction to Block chain | |
| | **BCE8612** | Android App Development with Kotlin | |
| | **BCE8613** | Agile Project Management | |

### Offered by Department of Civil Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCI8605A** | E- Waste Management | Choose any one |
| | **BCI8605B** | Advanced Instrumentation in Infrastructural Engineering | |
| | **BCI8605C** | MOOC (only for civil department student) | |
| VI | **BCI8606A** | 3-D Printing Technique for Construction | |
| | **BCI8606B** | Structural Health Monitoring and Audit | |

### Offered by Department of Electronics & Telecommunication Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BET8601** | Bio- Inspired Systems And Computing | Choose any one |
| | **BET8602** | Sensor and Automation using IoT | |
| | **BET8603** | MOOC | |
| VI | **BET8604** | Drone Technology. | |
| | **BET8605** | Advanced Driver Assistance System(ADAS) | |

## CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING

### SEMESTER – VII (Scheme – C)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | H | CR | FA | SA | TW | PR | OR | Total |
| BME7416 | PCC | Mechanical Vibrations and Acoustics | 3 | -- | - | 3 | 3 | 40 | 60 | -- | -- | -- | 100 |
| BME7417 | PCC | Mechanical Vibrations and Acoustics Lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME7418 | PCC | Refrigeration & Air Conditioning | 3 | -- | -- | 3 | 3 | 40 | 60 | - | - | -- | 100 |
| BME7419 | PCC | Refrigeration & Air Conditioning lab | -- | -- | 2 | 2 | 1 | -- | -- | 25 | -- | 50 | 75 |
| BME7505 | PEC | Professional Elective Course -V | 3 | -- | - | 3 | 3 | 40 | 60 | -- | - | - | 100 |
| BME7702 | PROJ | Project Stage I | - | -- | 12 | 12 | 6 | - | - | 100 | - | 50 | 150 |
| **TOTAL** | | | 9 | -- | 16 | 25 | 17 | 120 | 180 | 150 | - | 150 | 600 |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*



## Professional Elective Course

| Code | Professional Elective Course – V (BME7505) | |
|---|---|---|
| **BME7505A** | Computational Fluid Dynamics | Choose any one |
| **BME7505B** | Finite Element Analysis | |
| **BME7505C** | Operations Research | |
| **BME7505D** | Energy Storage & Management | |
| **BME7505E** | Data Analytics for Mechanical Engineering | |

## CURRICULUM STRUCTURE FOR FINAL YEAR B. TECH. MECHANICAL ENGINEERING

## SEMESTER – VIII (Scheme – C)

| Course Code | Course Type | Course Name | Teaching Scheme | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | H | CR | FA | SA | TW | PR | OR | Total |
| BME8506 | PEC | Professional Elective Course -VI | 3 | -- | - | 3 | 3 | 40 | 60 | - | - | - | 100 |
| BME8605 | OEC | Open Elective Course - V | 3 | -- | - | 3 | 3 | 40 | 60 | - | - | - | 100 |
| BME8606 | OEC | Open Elective Course - VI | 3 | -- | - | 3 | 3 | 40 | 60 | - | - | - | 100 |
| BME8702 | PROJ | Project Stage II | - | -- | 16 | 16 | 8 | - | - | 100 | - | 100 | 200 |
| BME8801 | INTR | Internship | - | - | - | - | 3 | - | - | 100 | - | - | 100 |
| **TOTAL** | | | **9** | **--** | **16** | **25** | **20** | **120** | **180** | **200** | **-** | **100** | **600** |

***Abbreviations are:*** *L-Lecture, P-Practical, T-Tutorial, H- Hours, FA- Formative Assessment, SA-Summative Assessment, TW –Term-work, PR-Practical, OR - Oral*

## Professional Elective Course

| Code | Professional Elective Course – VI (BME8506) | |
|---|---|---|
| **BME8506A** | Engineering Economics & Management | Choose any one |
| **BME8506B** | Reverse Engineering | |
| **BME8506C** | Robotics & Automation | |
| **BME8506D** | Steam Engineering & Energy Conservation | |
| **BME8506E** | Adhesive Technologies | |

# Open Elective Courses

## Semester-VIII

### Offered by Department of Information Technology – Semester VIII

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BIT8601** | Cloud Computing | - |
| VI | **BIT8602** | Data Science for Engineers | |

### Offered by Department of Computer Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCE8607** | Web Technology and its Applications | Choose any one |
| | **BCE8608** | Software Testing & Quality Assurance | |
| | **BCE8609** | MOOC Course | |
| VI | **BCE8610** | Database Management System | |
| | **BCE8611** | Introduction to Block chain | |
| | **BCE8612** | Android App Development with Kotlin | |
| | **BCE8613** | Agile Project Management | |

### Offered by Department of Civil Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BCI8605A** | E- waste management | Choose any one |
| | **BCI8605B** | Advanced Instrumentation in Infrastructural Engineering | |
| | **BCI8605C** | MOOC (only for civil department student) | |
| VI | **BCI8606A** | 3-D Printing Technique for Construction | |
| | **BCI8606B** | Structural Health Monitoring and Audit | |

### Offered by Department of Electronics & Telecommunication Engineering

| Open Elective | Code | Name of Open Elective Course | |
|---|---|---|---|
| V | **BET8601** | Bio- Inspired Systems And Computing | Choose any one |
| | **BET8602** | Sensor and Automation using IoT | |
| | **BET8603** | MOOC | |
| VI | **BET8604** | Drone Technology. | |
| | **BET8605** | Advanced Driver Assistance System(ADAS) | |

# Course Syllabus

## Final Year B Tech – Scheme A/B/C

## Semester-VII/VIII

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII | |
|---|---|---|---|---|---|---|---|
| Course: | Mechanical Vibrations and Acoustics | | | | | Code: BME7416/ BME8416 | |
| Teaching Scheme | | | | Evaluation Scheme | | | |
| Lecture | Practical | Hours | Credit | FA | SA | OR | Total |
| 3 | -- | 3 | 3 | 40 | 60 | -- | 100 |

**Prior knowledge of:**

a. Applied Mechanics

b. Engineering Physics

c. Engineering Mathematics….are essential

**Course Objectives:**

1. To enable students to understand the fundamental concepts of mechanical vibrations and noise.
2. To formulate mathematical models and complete solution of mechanical vibration problem.
3. To understand the various techniques of measurement and control of vibration and noise.

**Course Outcomes:**

The students will be able to,

1. Estimate the unbalance and apply the technique for balancing.
2. Formulate the equations of motion for the given vibratory systems
3. Examine the vibration response of a free damped single degree of freedom system
4. Investigate the vibration response of single degree of forced vibration system.
5. Investigate dynamic characteristics of two degree of freedom systems.
6. Demonstrate fundamental concepts of Acoustics, measurement and control

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Balancing of Masses**<br>Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single-cylinder engines, balancing in multi-cylinder in-line engines, | 7 |
| 2 | **Single Degree of Freedom Systems – Free Vibration**<br>Elements of a vibratory system, degrees of freedom, Classification of vibration, SHM, Mathematical modeling of vibratory systems, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)<br>Un-damped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems. | 8 |
| 3 | **Damped free vibrations**<br>Different types of damping, Viscous damping - over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations. | 7 |
| 4 | **Single Degree of Freedom Systems - Forced Vibrations** | 7 |

| | | |
|---|---|---|
| | Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility, Vibration isolation. | |
| **5** | **Two Degree of Freedom System**<br>Introduction to two degrees of freedom system, Equation of motion, Eigen Values and Eigen Vectors, Coordinate coupling and principal coordinates, Normal mode analysis, Properties of mode shapes, Forced vibration, Vibration absorber,<br>Introduction to Multi Degree of Freedom Systems and Continuous Vibrations of beam | **8** |
| **6** | **Acoustics**<br>Introduction to acoustics, loudness, decibel scale, adding decibels, weighting sound levels (A, B, C, Z) octave band, sound pressure, and power levels, sound fields – near, far and free and reverberant, inverse square law, wave number, sound intensity, noise measurement, reflection and transmission, radiation, absorption and attenuation at the Source, along the path and at the receiver, Reverberation chamber, Anechoic Chamber, Noise standards. | **8** |
| | **Total** | **45** |

**Text Books:**


1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi. 6th Ed 2016
2. Randell Barron, Industrial Noise Control and Acoustics, Marcel Dekker Inc 2003
3. S. S. Rattan, Theory of Machines, 5th Ed , 2019 McGraw Hill Education (India) Pvt. Ltd. New Delhi.


**Reference books:**


1. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee
2. Kelly SG, Mechanical Vibrations, 2013, Mcgraw Hill (India) Ltd.,
3. W.T. Thomson, Theory of Vibration with Applications, 2013, 5th Edition, Prentice – Hall.
4. L. Meirovitch, Elements of Vibration Analysis, 2001, Tata McGraw-Hill: New Delhi.
5. Munjal M. L., Noise and Vibration Control, , 2013, World Scientific Publishers in

Collaboration with IISc Press, Singapore.

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII | |
|---|---|---|---|---|---|---|---|
| Course: | Mechanical Vibrations and Acoustics Lab | | | | | Code: BME7417/BME8417 | |
| Teaching Scheme | | | | Evaluation Scheme | | | |
| Lecture | Practical | Hours | Credit | TW | ORAL | PR | Total |
| -- | 2 | 2 | 1 | 25 | 50 | - | 75 |

**Prior knowledge of**

a. Applied Mechanics
b. Engineering Physics
c. Engineering Mathematics….are essential

**Course Objectives:**

1. To impart knowledge to perform vibration analysis and Noise Analysis by estimation of different characteristics for mechanical applications.
2. To understand the various techniques of measurement and control of vibration and noise.

**Course Outcomes:**

The students will be able to,

1. Estimate the unbalance and apply the technique for balancing.
2. Determine the natural frequency and damping of vibrations that contains single and two degree of freedom system.
3. Estimate the vibration response of single degree of forced vibration system.
4. Estimate different characteristics of vibrations and of noise, measurement and control.
5. Simulate the response of damped, undamped, free and forced single degree of freedom vibrating system.

**Detailed Syllabus:**

**List of experiments/ tutorials (Any 8)**

1. Balancing of the rotor
2. To determine the natural frequency of a single-degree freedom system's damped vibration and find its damping coefficient.
3. To obtain frequency response curves of single degree freedom vibration system for different damping amounts.
4. To determine the natural frequency of free vibration of two rotor systems and determination of node position.
5. Determination of natural frequency and damping of the beam using an FFT analyzer and accelerometer
6. Motion Transmissibility
7. Effectiveness of Vibration control
8. Measurement of Noise & evaluation of its characteristics
9. Effectiveness of noise control
10. Machine fault detection based on vibration parameters with Machine learning.
11. Simulation of a Single Degree of Freedom Free / Forced vibration System to understand the effect of different system parameters on the vibrational behavior

| | **Total** | **24 Hrs** |
|---|---|---|

**Text Books:**

1. Mechanical Vibration and Acoustics Lab Mannual
2. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi.
3. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee
4. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.

**Reference books:**

1. Kelly SG, Mechanical Vibrations, 2013, Mcgraw Hill (India) Ltd.,
2. W.T. Thomson, Theory of Vibration with Applications, 2013, 5th Edition, Prentice – Hall.
3. L. Meirovitch, Elements of Vibration Analysis, 2001, Tata McGraw-Hill: New Delhi.
4. Munjal M. L., Noise and Vibration Control, , 2013, World Scientific Publishers in
5. Collaboration with IISc Press, Singapore.

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII |
|---|---|---|---|---|---|---|
| Course: | Refrigeration and Air Conditioning | | | | | Code: BME7418/ |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of :**

a. Engineering Thermodynamics

b. Fluid Mechanics

c. Heat transfer….are essential

**Course Objectives**

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Calculation of cooling load and heating load for different applications.
5. Study of the various equipment, operating principles employed in refrigeration air conditioning systems.
6. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.

**Course Outcomes:**

After learning the course, Students will be able to …

1 **Evaluate** performance of single/multistage Vapour Compression System

2 **Select** refrigerants for various applications and **analyze** vapour absorption refrigeration system.

3 **Select** different components of refrigeration and air conditioning systems.

4 **Estimate** cooling load and heating load for different applications.

5 **Design** air conditioning systems for comfort air conditioning.

6 **Design** air distribution system

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Simple Vapour Compression Refrigeration Systems:**<br>Reverse Carnot cycle, Representation of VCR cycle on P-h and T-s diagram, Effect of subcooling, superheating, evaporator and condenser pressure on VCR Cycle, Actual VCR. (Numerical treatment)<br>Limitations of single compressor system for large pressure ratio, Multistage compression with flash inter cooler, Individual compressor with multiple evaporator and multiple expansion valve.$CO_2$-$NH_3$ cascade systems, Advanced Refrigeration Systems. | 8 |
| 2. | **Refrigerants:**<br>Designation of refrigerants, Desirable properties of Refrigerant: - Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Ozone depletion and global warming, ODP, GWP., Environmental protocols.<br>**Vapour Absorption Refrigeration Systems:** | 8 |

| | | |
|---|---|---|
| | Simple Vapour Absorption System, Maximum COP of VAS, Actual Vapour Absorption System, Ammonia- Water, LiBr- water (single and double effect) VAS. | |
| **3.** | **Equipment used in Refrigeration and Air Conditioning:**<br>Classification of Refrigerant Compressors, Reciprocating Compressors and Centrifugal Compressors, screw and Scroll compressors, Performance characteristics of reciprocating and centrifugal compressor, Types of Evaporators: - Direct Expansion (DX), flooded evaporator, Types of Expansion Devices: - Capillary tube, Automatic/constant pressure Expansion Valve, Thermostatic Expansion Valve (TXV), Electronic expansion valve (EEV). | **6** |
| **4.** | **Cooling Load Calculations**<br>Heat transfer through building structure (fabric heat gain , fenestration), Overall heat transfer coefficient, Internal Heat Gains: Occupancy load, Lighting load, Appliances load, Product load, System Heat Gains: Supply air duct and leakage loss, Heat gain from fan, return duct heat gain and leakage gain, ventilation and infiltration load.<br>Concept of decrement factor and time lag, CLTD/ETD method. | **8** |
| **5.** | **Applied Psychometry and Air Conditioning systems:**<br>Psychrometric terms, Psychrometric Relations, Psychrometric Processes, Bypass Factor of Heating and Cooling Coil, Adiabatic mixing of two streams, Psychrometric Chart, Human Comfort, Psychrometric processes in summer air conditioning system, Room Sensible Heat Factor, Grand Sensible Heat Factor, Effective Sensible Heat Factor. Types of AC systems: Summer, Winter, VRF | **8** |
| **6.** | **Air distribution systems:**<br>Classification of ducts, duct material, total, static and velocity pressure in ducts, pressure losses in duct (friction losses, dynamic losses), duct friction chart, equivalent diameter of rectangular duct, equal friction methods of duct system design | **7** |
| | **Total** | **45** |

**Text Books:**


1 Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill, 3rd Edition, 2017

2 Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 3rd Edition, 2021


**Reference Books:**


1 Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 4th Edition, 2002.

2 ASHRAE & ISHRAE handbook.

3 Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions, 1982.

4 Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi

5 Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications

6 Roger Legg, Air Conditioning System Design, Commissioning and Maintenance

| Program: | B. Tech. (Mechanical Engineering) | | | | | | Semester: VII/VIII |
|---|---|---|---|---|---|---|---|
| Course: | Refrigeration and Air Conditioning Lab | | | | | | Code: BME7419/BME8419 |
| Teaching Scheme | | | | Evaluation Scheme | | | |
| Lecture | Practical | Hours | Credit | TW | OR | PR | Total |
| - | 2 | 2 | 1 | 25 | 50 | - | 75 |

**Prior knowledge of:**

a. Engineering Thermodynamics
b. Fluid Mechanics
c. Heat transfer….are essential

**Course Objectives**

1. Understanding of vapour compression system
2. Calculating the performance of vapor compression refrigeration system
3. Calculation of cooling load and heating load for different applications.
4. Study of the various equipment, operating principles employed in refrigeration air conditioning systems.

**Course Outcomes:**

After learning the course, Students will be able to …

1. **Evaluate** performance of single Vapour Compression System
2. **Estimate** cooling load and heating load for different applications.
3. **Design** air conditioning systems for comfort air conditioning.

**Practical (24 hours)**

(Any four out of 1,2,3,4,6,10 is compulsory and total 8 practical are to be completed by the students).

**Following practical are to be completed.**

1 Trial on Vapour Compression test rig.

2 Trial on Vapour Absorption test rig (Electrolux Refrigerator).

3 Trial on Heat Pump test rig.

4 Trial on Ice Plant test rig.

5 Trial on Air Conditioning test rig.

6 Performance analysis of cooling tower.

7 Visit to any air conditioning plant.

8 Case study on design of Refrigeration Systems for cold storage plant (Use of ISHRAE standards).

9 Case study on design of ducts using ISHRAE standards.

10 Analysis of VCR cycle using suitable software

11 Design of 2 TR refrigeration system including selection of components.

12 Feasibility of vapour absorption chillers Over compression chillers

**Text Books:**

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill, 3rd Edition 2017
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 3rd Edition 2021

**Reference Books:**

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 4th Edition 2002.
2. ASHRAE & ISHRAE handbook.
3. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
4. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi
5. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications
6. Rogr Legg, Air Conditioning System Design, Commissioning and Maintenance

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII/VIII | |
|---|---|---|---|---|---|---|
| Course: | Computational Fluid Dynamics (Professional Elective –V) | | | | Code: BME7505A/ BME8505A | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | -- | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Engineering Mathematics
b. Fluid Mechanics
c. Thermodynamics
d. Heat Transfer
e. Numerical Methods
f. Programming Languages… are essential

**Course Objectives:**

1. Students will be able to understand the basics of conservation laws and transport mechanisms of fluid-dynamics and numerical methods used for obtaining solution and calculation of engineering-parameters in CFD.
2. Algebraic formulation: develop the ability to do discretization by finite difference method and finite volume method.
3. Students should be able to solve basic convection and diffusion equations and understands the role in fluid flow and heat transfer.
4. CFD application and analysis: Learn to solve various problems in fluid dynamics and heat-transfer using software tools; and analyze as well as discuss the results.

**Course Outcomes:**

The students will be able to,

1. Apply governing equations to solve heat transfer and fluid flow problems.
2. Apply suitable descritization techniques to solve conduction equation.
3. Apply suitable descritization techniques to solve Advection equation.
4. Solve Convection-Diffusion equation using suitable descritization techniques and Analyze the solution.
5. Apply CFD methodology and select suitable flow model for analysis of real life problems.
6. Classify the flow type and numerically solve and analyze for the internal and external flow physics.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to CFD**<br>Introduction to Computational Fluid Dynamics, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions. | 7 |
| 2 | **Solution to Conduction Equation** Introduction to FDM and FVM, Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Concept of Stability Criteria. | 7 |

| | | |
|---|---|---|
| **3** | **Solution to Advection Equation**<br>Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first and second order upwind, and QUICK convection schemes. | **7** |
| **4** | **Solution to Convection-Diffusion Equation**<br>Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number | **8** |
| **5** | **CFD Simulation and Analysis using software tool**<br>Guidelines for geometric modeling using modeling software tool, Grid generation and quality criteria, Guidelines for Boundary Conditions, Solution techniques and methodology. | **8** |
| **6** | **CFD Simulation of Internal and External case studies using software tool**<br>Internal Flows: Flow through pipe – partially developed and fully developed flow, forward and backward step flows.<br>External Flows: Flow over circular cylinder, flow over an airfoil, flow separation. | **8** |
| | **Total** | **45** |

**Text Books:**


1. Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Ane Books Pvt. Ltd., Springer, 2022.
2. H. Versteeg, and W.Malalasekara, An Introduction to Computational Fluid Dynamics: The Finite Volume, 2 nd Ed., Method, Pearson, 2011.
3. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier, 2018.


**Reference books:**


1. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2012
2. H. Schlichting and K. Gersten, Boundary-Layer Theory, Springer, 2017.
3. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, CRC Press, 2018.
4. W. Date, Introduction to Computational Fluid Dynamics, Cambridge Univ. Press, USA, 2012.
5. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw-Hill, 2012.
6. David C. Wilcox, Turbulence Modeling for CFD, DCW Industries, 2006.

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII/VIII | |
|---|---|---|---|---|---|---|
| Course: | Finite Element Analysis (Professional Elective –V) | | | | Code: BME7505B/ BME8505B | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Mathematics

b. Strength of Materials

c. Machine Design…… are essential

**Course Objectives:**

1. To understand the philosophy and general procedure of the Finite Element Method applied to solid mechanics and thermal analysis problems.
2. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
3. It provides a bridge between hand calculations based on the mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
4. To study the approximate nature of the finite element method, and convergence of results are examined.

**Course Outcomes:**

After learning the course, the students should be able to

1. Apply the FEA method and develop finite element formulations of engineering problems from a variety of applications.
2. Solve 1D problem like spring, bar, beam, and Plane frame for displacements and stresses.
3. Derive and use 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
4. Apply numerical integration methods to solve isoparametric element problems.
5. Solve 1D Steady State Heat Transfer Problems.
6. Solve Dynamic problems and will learn to formulate Mass matrices of bar and beam element.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Fundamental Concepts of FEA**<br>Introduction: Solution methodologies to solve engineering problems, governing equations, mathematical modelling of field problems in engineering, discrete and continuous models. Brief history of FEM, Finite Element terminology (nodes, elements, domain, continuum, degrees of freedom, loads & constraints), general steps involved in FEM, applications of FEM in various fields, advantages and disadvantages of FEM, consistent units system, essential and natural boundary conditions, symmetric boundary conditions. Introduction to different approaches used in FEA | 8 |
| 2. | **1D Elements**<br>Types of 1D elements, displacement function, Pascal's triangle, compatibility, and completeness requirement, geometric isotropy, convergence requirements, global , local and Natural coordinate systems, Interpolation functions- linear, quadratic, properties of shape function, primary and secondary variables. | 9 |

| | | |
|---|---|---|
| | Formulation of elemental stiffness matrix and load vector for Spring, bar, and truss using any approach, Numerical | |
| **3.** | **2D Elements**<br>Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations Constant Strain Triangle(CST), Linear Strain Triangle (LST) , geometry associative mesh, quality checks, mesh refinement- p vs h refinements, displacement function, Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems | **8** |
| **4.** | **Isoparametric Elements and Numerical Integration**<br>Concept of isoparametric elements, Terms isoparametric, super parametric, and subparametric.<br>Coordinate mapping: Natural coordinates, Area coordinates (for triangular elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), Numerical integration: Gauss Quadrature in one- and two-dimension sub-modeling, substructuring. | **6** |
| **5.** | **1D Steady State Heat Transfer Problems**<br>Introduction, Formulation of load vector due to uniform temperature change (only for bar). One dimensional steady-state heat transfer problem- Governing differential equation, Finite Element formulation using Galerkin's approach for composite wall and thin Fin , essential and natural boundary conditions and solving for temperature distribution | **7** |
| **6.** | **Dynamic Analysis**<br>Types of dynamic analysis, general dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar, truss, and beam element.<br>Undamped-free vibration: Eigenvalue problem, evaluation of eigenvalues and eigenvectors (characteristic polynomial technique). | **7** |
| | **Total** | **45** |

**Text Books:**


1. Daryl L, A First Course in the Finite Element Method,. Logan, 5th Revised ed. 2010.
2. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 4th Revised edition 2012
3. P. Seshu, Text book of Finite Element Analysis, PHI Learning Private Ltd. , New Delhi, 2010.


**Reference Books:**


1. Bathe K. J., Finite Element Procedures Prentice, Hall of India (P) Ltd., New Delhi.
2. Gokhale N. S., et al., Practical Finite Element Analysis, Finite to Infinite, Pune, 2020.

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII/VIII | |
|---|---|---|---|---|---|
| Course: | Operation Research (Professional Elective –V) | | | Code: BME7505C/ BME8505C | |
| Teaching Scheme | | | Evaluation Scheme | | |
| Lecture | Hours | Credit | FA | SA | Total |
| 3 | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Engineering Mathematics
b. Theory of Probability
c. Statistics,
d. Basic Industrial Functions and Business Environment … are essential

**Course Objectives:**

1. To enable students to understand the fundamental concepts of mechanical vibrations and noise.
2. To formulate mathematical models and complete solution of mechanical vibration problem.
3. To understand the various techniques of measurement and control of vibration and noise.

**Course Outcomes:**

The students will be able to,

1. **EVALUATE** various situations in Decision techniques and **APPLY** them to solve them in real life for decision making
2. **FORMULATE** variety of problems such as transportation, assignment, travelling salesman and **SOLVE** these problems using linear programming approach
3. **SELECT** appropriate model for queuing situations and sequencing situations and **FIND** the optimal solutions using models for different situations
4. **PLAN** optimum project schedule for network models arising from a wide range of applications
5. **EVALUATE** various situations of Games theory
6. **APPLY** concepts of simulation

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to OR, and Decision Analysis**<br>**Introduction to OR**: Origin of Operations Research, Definition, Evolution and Classification of Quantitative methods, Operations Research Techniques and Methodology, Advantages and Limitations, Scope and Applications of OR<br>**Decision Analysis:** Introduction, Decision Under Certainty, Decision Under Risk, Decision Under Uncertainty (Maximin, Minimax, Maximax, Minimin Criterions, Hurwicz Criterion, Laplace Criterion, Savage or MiniMax Regret Criterion), Decision Tree. | 9 |

| | | |
|---|---|---|
| **2** | **Transportation and Assignment Model**<br>**Transportation Model**: Introduction, Formulation of Transportation problem, Methods to Find Basic Feasible Solution (Vogel's Approximation Method (VAM), Least Cost Method (LCM), North West Corner Rule (NWCR)), Unbalanced Transportation Problem, Degeneracy in Transportation Problem (Theoretical treatment only), Optimality Test- Modified Distributed Method<br>**Assignment Model**: Introduction, Mathematical Formulation of Assignment Problem Difference between Transportation and Assignment Problem Assignment Problem, Hungarian Method, Balanced and Unbalanced Assignment problem, Maximization in Assignment Problems, Travelling Salesman Problem (Mathematical Formulation and Numerical) | **8** |
| **3** | **Queuing Theory and Sequencing Model**<br>**Queuing Theory**: Introduction, Elements of Queuing, Characteristics of Waiting Lines, Service discipline, Service Mechanism, Terminology and Kendall's Notation of Queuing system, Single Channel systems M/M/1: FCFS/ / and M/M/1: FCFS/ /<br>**Sequencing Models**: Solution of Sequencing Problem - Processing of n Jobs Through Two Machines, Processing of n Jobs Through Three Machines, Processing of Two Jobs Through m Machines, Processing of n Jobs Through m Machines | **6** |
| **4** | **Network Models**<br>Fulkerson's Rule, Concept and Types of Floats, CPM and PERT, Crashing Analysis and Resource Scheduling | **8** |
| **5** | **Theory of Games**<br>Introduction, Classification of Games, Two-person Zero Sum Games, Solution of 2 x 2 Game with no Saddle Point, Dominance in Games, Subgame Method to Solve (2 x n or m x 2) Mixed Strategy Games, Graphical Method to Solve (2 x n or m x 2) | **7** |
| **6** | **Simulation**:<br>Introduction, Simulation Definition, Types of Simulation, Steps of Simulation, Advantages and Disadvantage of simulation, Stochastic Simulation and Random numbers, Monte Carlo simulation, Random number Generation | **7** |
| | **Total** | **45** |

**Text Books:**


1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India, 2010.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut, 2015.
4. L.C.Jhamb, Quantative Techniques Vol. I &II, Everest Publication, 2007.
5. Manohar Mahajan, Operation Research, Dhanpatrai Publication, 2006.
6. V. K. Kapoor, Operations Research: Quantitative Techniques for Management, Sultan Chand Publications, 2013.


**References:**


1. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India, 2011.
2. Ravindran, ―Engineering optimization Methods and Applications‖, 2nd edition, Wiley, India
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
4. **4.** Operations Research - An introduction, Hamdy A Taha, Pearson Education, 2010

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Energy Storage & Management (Professional Elective –V) | | | | | Code: BME7505D/ BME8505D |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Fundamentals of Engineering

b. basic sciences… are essential

**Course Objectives:**

1. To explore energy storage systems' fundamentals, technologies, and applications.
2. To enable students to understand the principles of energy storage systems design.
3. To provide a general awareness of energy storage audit, safety, and management.

**Course Outcomes:** The students will be able to,

1. **Differentiate** and **select** energy storage systems based on performance and safety.
2. **Select** the appropriate material and **analyze** the energy storage in thermo-chemical form.
3. **Describe** hydrogen and mechanical energy storage and production mechanisms.
4. **Describe and Analyze** energy storage in batteries, super-capacitors, and fuel cells.
5. **Design** and **Analyze** batteries for transportation.
6. **Design** audit for Energy Systems

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Energy storage system:** Introduction, Need, Modes, Energy storage devices, Merits, and Demerits of different types of Storage, utilization, and system applications.<br>**Performance:** Energy capture rate and efficiency, Discharge rate and efficiency, Dispatch ability and load flowing characteristics, Scale flexibility, durability, Cycle lifetime, mass. | 8 |
| 2 | **Thermal storage system –** Thermal storage system-heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems. | 6 |
| 3 | **Chemical storage system-** hydrogen, methane, etc., the concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.<br>**Mechanical energy storage:** Flywheel Energy Storage, Pumped Hydro Energy Storage Systems, Kinetic Energy, and Compressed Air Energy Storage Systems.<br>**Hybrid energy storage systems**: configurations and Applications | 8 |
| 4 | **Electrochemical storage system**<br>**Batteries-** Working principle, primary and secondary (flow) batteries, performance evaluation methods, major battery chemistries, and their voltages, Li-ion & Metal hydride vs. lead-acid battery.<br>**Super capacitors**- Working principle, types, Cycling and performance characteristics, the difference between battery and super capacitors, Hybrid electrochemical super capacitors | 9 |

| | | |
|---|---|---|
| | **Fuel cell**: Operational principle, types, hybrid fuel cell-battery systems, hybrid fuel cell-super capacitor systems, | |
| **5** | **Battery design for transportation:** Mechanical Design and Packaging of Battery, Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Li-ion Batteries, Thermal run-away for battery systems,<br>**Battery Performance Parameter**: State of Charge and Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles | **8** |
| **6** | **Energy Storage Management**<br>Relationship between economic growth and energy use, Energy demand analysis in different economic sectors, increase energy conversion efficiencies by introducing energy storage, Energy audit of energy storage system, The carbon markets.<br>**Safety**: Risks of fire, explosion, toxicity, Ease of materials, recycling, and recovery, Environmental consideration, and recycling | **6** |
| | **Total** | **45** |

**Text Books:**


1. A. R. Pendse, "Energy Storage Science and Technology," SBS Publishers & Distributors, New Delhi, 2011.
2. Umesh Rathore, "Energy Management," S.K. Kataria and Sons, Reprint 2013 edition.
3. Jayarama Reddy, "Principles of energy storage systems," BSP Books, 2022.
4. Robbert Huggins, "Energy Storage- Fundamentals Materials and Application", Springer, 2016.


**Reference Books:**


1. Pistoia, Gianfranco, and Boryann Liaw. The behavior of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.
2. E. Lipman, A. Z. Weber, Fuel Cells and Hydrogen Production, A Volume in the Encyclopedia of Sustainability Science a Technology, Second Edition, Springer reference.
3. Modern electric, hybrid electric, and fuel cell vehicles fundamentals, theory, and design by Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, CRC press.
4. Electric Power Research Institute (USA), "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits" (1020676), December 2010.
5. Handbook of Energy Audit by Sonal Desai Publisher Tata McGraw Hill.
6. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion," John Wiley and Sons, 2012.
7. Francois Beguin and Elzbieta Frackowiak, "Supercapacitors," Wiley, 2013.

| Program: | B. Tech. (Mechanical Engineering) | Semester: VII/VIII |
|---|---|---|
| Course: | Data Analytics for Mechanical Engineering (Professional Elective –V) | Code: BME7505E/ BME8505E |

| Teaching Scheme | | | Evaluation Scheme | | |
|---|---|---|---|---|---|
| Lecture | Hours | Credit | FA | SA | Total |
| 3 | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Fundamentals of Mechanical Engineering
b. Engineering Mathematics and Statistics
c. Artificial Intelligence and Machine Learning
d. Numerical Methods
e. Probability and Statistics… are essential

**Course Objectives:**

1. To explore the fundamental concept of data analytics
2. To understand the various search techniques and visualization techniques
3. To apply various machine learning techniques for data analysis.
4. To explore and apply the Python package for data analytics.

**Course Outcomes:**

After learning this course, the students will be able to:

1. Explain the fundamentals of data analytics and select a suitable approach for data analytics
2. Apply descriptive analytics to describe and analyze the data.
3. Select suitable plots for the given data and draw practical interpretations.
4. Apply descriptive, diagnostic, predictive, and prescriptive analytics techniques to withdraw useful conclusions from the acquired data set.
5. Explore the data analytics techniques using various programming packages/ tools
6. Apply data science concepts and methods to solve problems in a real-world context

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction**<br>Data science and data analytics; Types of data, Data recording/ collecting; Data storing; Data pre-processing; Data describing/ visualization; Statistical modelling; Algorithmic modelling; Missing data treatment; Relationship between AI, ML, DL, and Data Science; Big data, Database system | 7 |
| 2 | **Descriptive Statistics**<br>Universe, population, and sample, Measures of central tendency and their characteristics; outlier detection, histogram and central tendency; measures of spread, variance, percentiles, Effect of the transformation of measure of spread | 7 |
| 3 | **Data Visualization**<br>Histogram, Bar/ line chart, Box plots, swarm plot, Violin plot, faceted plot, boxen plot, leaf and stem plots, Scatter plots, Heat map, pie chart, line plot. | 8 |
| 4 | **Data Analytics Approaches**<br>**Predictive analytics** – predictions using statistical modelling and machine learning techniques; demand forecasting; anomaly detection. | 8 |

| | | |
|---|---|---|
| | **Prescriptive analytics –** process improvement decisions, supplier reviewing, maintenance scheduling<br>**Descriptive analytics –** trends and patterns in the data, data visualization tools;<br>**Diagnostics analytics –** root cause analysis, data mining, correlation, product quality analysis | |
| **5** | **Python for Data Analytics**<br>Platforms; Blocks – if, for, while, etc., list, tuples, sets, dictionaries, file handling; Libraries – Numpy, Pandas, Matplotlib, Seaborn, etc. File formats – csv, tsv, json, parquet; Data visualization tools – Power BI/ Tableau | **8** |
| **6** | **Applications**<br>Thermal/ Heat Transfer/ HVAC/ Fluid Mechanics/ Fluid Power, Solid Mechanics/ Design, Machining/ Manufacturing, Automation and Robotics, Maintenance/ reliability/ condition monitoring, Quality Control, Materials and metallurgy, Energy Conservation and Management, Industrial Engineering, Estimation, and Management, Automotive Technology | **7** |
| | **Total** | **45** |

**Text Books:**


1. Brunton, S. L., & Kutz, J. N. (2022). Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press.
2. Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press.
3. Roy, S. S., Samui, P., Deo, R., & Ntalampiras, S. (Eds.). (2018). Big data in engineering applications (Vol. 44). Berlin/Heidelberg, Germany: Springer.
4. Middleton, J. A. (2021). Experimental Statistics and Data Analysis for Mechanical and Aerospace Engineers. Chapman and Hall/CRC.
5. Brandt, S. (1970). Statistical and computational methods in data analysis.
6. Robinson, E. L. (2017). Data analysis for scientists and engineers. In Data Analysis for Scientists and Engineers. Princeton University Press.
7. Araghinejad, S. (2013). Data-driven modeling: using MATLAB® in water resources and environmental engineering (Vol. 67). Springer Science & Business Media.
8. Niu, G. (2017). Data-driven technology for engineering systems health management. Beijing, China: Springer.


**Reference Books:**


1. Zsolt Nagy, "Artificial Intelligence and Machine Learning Fundamentals", Packt Publishing, 2018, ISBN: 978-1-78980-165-1
2. Hastie, Trevor, Robert Tibshirani, Jerome H. Friedman, and Jerome H. Friedman. The elements of statistical learning: data mining, inference, and prediction. Vol. 2. New York: springer, 2009.
3. Zaki, Mohammed J., Wagner Meira Jr, and Wagner Meira. Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press, 2014.
4. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.


**E-sources:**

https://padhai.onefourthlabs.in/courses/data-science

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII/VIII | |
|---|---|---|---|---|---|---|
| Course: | Electric, autonomous and connected vehicle technology-II | | | | Code: BME7506F/ BME8505F | |
| Teaching Scheme/week | | | | Evaluation Scheme | | |
| Lecture | Practical | Credit | Hours | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of**

a. Fundamentals of Electric, autonomous and connected vehicles technology

**Course Objectives:**

1. Understand the design, architecture, safety considerations and troubleshooting of electric vehicle (EV) powertrain.
2. Develop a foundational understanding of computer vision and image processing techniques for Autonomous vehicles
3. Understand the integration of wireless networking with on-board vehicle networks to enhance vehicle connectivity
4. Explore vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2X) communication technologies
5. Understand the integration of in-car assistance, multimedia and infotainment systems
6. Learn to implement a connected vehicle platform that integrates vehicle connectivity, data storage and analysis

**Course Outcomes:**

The students will be able to,

1. Analyze EV powertrain systems while ensuring high voltage safety, diagnosing and troubleshooting failures.
2. Apply image processing and computer vision techniques to solve complex visual tasks of Autonomous vehicles
3. Implement and evaluate integrated wireless and on-board network systems to improve vehicle connectivity
4. Analyze V2V and V2X communication systems and assess wireless security measures to ensure the safety and reliability of connected vehicles.
5. Implement and secure advanced in-car assistance, multimedia, and infotainment systems
6. Develop and deploy a connected vehicle platform that effectively connects vehicles, stores and analyzes data

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | Traction System Topology for EV Applications, EV Powertrain Architecture and design, High voltage safety, Onboard charger and Charging Station, Failure mode Analysis and Diagnostic<br>Maintenance Guidelines and Troubleshooting for EV | 8 |
| 2 | Introduction to Computer Vision , Image processing technique, Edge and Line Detection Techniques- CANNY/ HOUGH, Transformation, Projective and Stereo Geometry, 3D Computer Vision<br>Feature Extraction- Image Classification using ANN,CNN, PCA (Principal Component Analysis) | 8 |
| 3 | Integration of Wireless Networking and On-Board Vehicle Networks<br>Review of On-Board Networks – Use & Function for Cars | 7 |

| | | |
|---|---|---|
| | Connectivity Fundamentals (Car to Networks and within Car)<br>Navigation and Other Applications | |
| **4** | Vehicle-to-Vehicle Technology and Applications - V2V<br>Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications - V2X<br>Wireless Security Overview And how it impacts Connected cars | **8** |
| **5** | In Car Assistance, Multimedia and Infotainment, Android Auto/ Apple Car play, Car as a Platform, Fastag, GPS, Introduction to Automotive Cybersecurity | **7** |
| **6** | Building a connected Vehicle Platform connecting vehicles, storing and analyzing data and building consumer application as a Case Study | **7** |
| | **Total** | **45** |

**Reference books:**


1. Jiajia Liu, Abderrahim Benslimane, Intelligent and Connected Vehicle Security, River Publishers Series, 2021.
2. Zakir, Abdul Hamid ,Fadi Al-Turjman, Towards Connected and Autonomous Vehicle Highways, Technical, Security and Social Challenges, Springer, 2021
3. Sean Bennett, Electric Vehicles: A Systems Approach, G-W publishers, 2024
4. Sumit Ranjan, Dr. S. Senthamilarasu, Applied Deep Learning and Computer Vision for self driving cars, Packt publication, 2020.

| Program: | B. Tech. (Mechanical Engineering) | Semester: VII/VIII |
|---|---|---|
| Course: | Engineering Economics and Management (Professional Elective –VI) | Code: BME7506A/ BME8506A |

| Teaching Scheme | | | | Evaluation Scheme | | |
|---|---|---|---|---|---|---|
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | -- | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

NIL

**Course Objectives:**

1. Acquire knowledge of management principles and economics to facilitate the process of economic decision making.
2. Acquire knowledge on basic marginal costing aspect.
3. Develop the skills to analyse financial aspects of product.

**Course Outcomes:**

After learning this course, the students will be able to:

1. Understand and apply principles of management to various types of production systems.
2. Identify different elements of costs.
3. Apply marginal costing theory to calculate breakeven point.
4. Identify and compare performance of cost centers.
5. Conduct job evaluation and merit rating.
6. Apply value analysis and value engineering techniques for cost optimization.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Management:** Nature of management and its process, Functions and principles of management, Contribution of Taylor and Fayol to management, Industrial ownership- Types, formation, merits and demerits, Management by objective, Management by exception | 7 |
| 2. | **Engineering Economics:** Introduction, Cost accounting and financial accounting, concept of cost centre, elements of costs, cost sheet/cost statement, methodology of costing. | 7 |
| 3. | **Marginal Costing:** Features of marginal costing, cost-volume profit relationship. | 8 |
| 4. | **Standard Costing:** Concept of standard costing, standard costing vs budgetary control, analysis of variance, cost and financial audits, cost reduction vs cost control, | 8 |
| 5. | **Job evaluation and merit rating:** Introduction, definition, objectives and procedure for job evaluation, Job analysis, description, Specification, Job evaluation systems, Merit rating. | 8 |
| 6. | **Value engineering and value analysis**: Origin, meaning, definition of value engineering, value analysis and value engineering, uses, value engineering vs cost reduction techniques, steps in value analysis, Function analysis system technic, ten commandments of value analysis | 7 |
| | **Total** | **45** |

**Text Books:**


1. S.M. Inamdar, Cost and Management Accounting, Everest Publishing House,21st Edition
2. Martand Telsang, Indistrial Engineering and Production Management, S.Chand, 2004.


**Reference Books:**


1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson Education
5. R.Paneer Seelvan: Engineering Economics, PHI


| Program: | B. Tech. (Mechanical Engineering) | Semester: VII/VIII |
|---|---|---|

| Course: | Reverse Engineering (Professional Elective –VI) | | Code: BME7506B/ BME8506B | | |
|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | |
| Lecture | Hours | Credit | FA | SA | Total |
| 3 | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Product design and development
b. Rapid prototyping…….are essential

**Course Objectives:**

1. Applying the fundamental concepts and phases of reverse engineering in product design and development.
2. Applying the methodologies, techniques and selection process of reverse engineering for product design and development.
3. Impart the knowledge of reverse engineering and rapid prototyping applied to industrial applications.
4. Impart the knowledge of legal aspects and barriers to adopting reverse engineering.

**Course Outcomes:**

After learning this course, the students will be able to:

1. Classify the phases of reverse engineering for geometric model development.
2. Relate methodologies and techniques of reverse engineering system.
3. Apply the hardware and software knowledge in selecting of reverse engineering process.
4. Correlate relationship between reverse engineering and rapid prototyping and industrial applications.
5. Plan reverse engineering for industrial applications with case studies.
6. Use knowledge of legal aspects and barriers to adopt reverse engineering.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction:** History of Reverse Engineering, scope of reverse engineering, definition, application. Reverse engineering fundamentals-The generic process-Three phases of reverse engineering-Phase I: Scanning, Phase II: Point processing, Phase III: Geometric model development. | 7 |
| 2. | **Methodologies and Techniques:** Methodologies and techniques of Reverse Engineering: RE using contact method, coordinate measuring machine and robotic arms, Computer aided reverse engineering, Computer vision and reverse engineering, Structured light range imaging, Scanner pipeline. | 8 |
| 3. | **Hardware and Software:** Reverse engineering hardware and software: Introduction, Reverse engineering hardware, Reverse engineering software, 3-D data collection techniques, Need of pre-processing, import of point cloud data reduction and filtering. Selection of a reverse engineering system. | 7 |
| 4. | **Rapid Prototyping:** Introduction to rapid prototyping: Need & Development of RP systems, RP process chain, Impact of Rapid prototyping and Tooling on Product Development, Benefits, Digital prototyping, Virtual prototyping, Applications, Relationship between reverse engineering and rapid prototyping. | 8 |
| 5. | **Reverse Engineering: An industrial Perspective:** Introduction and applications of reverse engineering in automotive, aerospace and medical industry, Case studies with implementation.. | 8 |
| 6. | **Legal Aspects and Barriers** Legal aspects of reverse engineering: Introduction, copyright laws, recent case law, Barriers to adopt reverse engineering: background, research model, Factor Analysis Approach. | 7 |
| | **Total** | 45 |

**Text Books:**

1. Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, McGraw Hill, Fifth Edition, 2020.

**Reference books:**

1. Reverse Engineering: Mechanisms, Structures, Systems and Materials, Robert W. Messler, Jr., 2014 by McGraw-Hill Education.
2. Tiago Franco, Beatriz Costa, and Maria Grilo, Product Design Process: The manual for Digital Product Design and Product Management, Imaginary Cloud Limited (8 May 2019).
3. Wego Wang, Reverse Engineering: Technology of Reinvention, CRC Press Taylor & Francis Group, 2011.

**E-sources:**

1. https://archive.nptel.ac.in/courses/112/104/112104265/
2. https://archive.nptel.ac.in/courses/112/104/112104265/

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII/ VIII | | |
|---|---|---|---|---|---|---|
| Course: | Robotics and Automation (Professional Elective –VI) | | | Code: BME7506C/ BME8506C | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | -- | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Solution of Matrices
b. Kinematics of Mechanisms
c. Force analysis of Mechanism
d. Mechatronics…….. are essential

**Course Objectives:**

Students are expected to study,

1. Classification of robots and homogeneous transformation of matrix
2. Represent the robot in matrix form and perform Direct and Inverse kinematics
3. Velocity and static force analysis of the robot
4. Generation of required trajectory
5. Design of various grippers
6. Automation in the industry using the robots

**Course Outcomes:**

The students will be able to,

1. **Classify** robots and **Solve** homogeneous transformations
2. **Analyze** the Forward and Inverse kinematics of a robot
3. **Analyze** the Velocity and Static force of a robot
4. **Generate** trajectory for a given path
5. **Analyze and Design** a gripper
6. **Understand** the fundamentals of Automation

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Fundamentals of robotics**<br>Structure of a robot. Classification and applications of Robots. Robot anatomy. Dexterity and compliance of robots.<br>Description of frame in the robotic system. Homogeneous transformations and mapping of frames. | **7** |
| 2. | **Robot Architecture and Kinematics**<br>Representation of joints and links using Denavit-Hartenberg parameters. Direct and Inverse kinematics of robots. | **8** |
| 3. | **Velocities and static forces**<br>Linear and angular velocity of links, velocity propagation, manipulator Jacobians, Manipulability, Singularity analysis, Static forces in manipulators | **8** |

| | | |
|---|---|---|
| 4. | **Motion Planning and Programming**<br>Considerations in the path description. Joint space schemes, Cartesian space schemes. Geometric problems with paths.<br>introduction to robot programming languages | **8** |
| 5. | **Robot Grippers**<br>Types of Grippers. Gripper design, and force analysis for various basic gripper systems. | **7** |
| 6. | **Fundamentals of Automation**<br>Automation in Production System, Principles, Strategies, and classification of Automation, Basic Elements of an Automated System. Types of automation. Role of robots in automation. | **7** |
| | **Total** | **45** |

**Text Books:**


1. Deb, S. R., Deb, S., (2017), "Robotics Technology and Flexible Automation," McGraw Hill Education, ISBN: 9780070077911
2. Saha, S. K., (2017), "Introduction to Robotics" McGraw-Hill Education, ISBN: 9789332902800
3. Craig, J., (2021), Introduction to Robotics: Mechanics and Control, Pearson, ISBN: 9781292164939
4. Ray Asfahl, C., (1992), "Robots and Manufacturing Automation," Wiley, ISBN: 9780471553915
5. Nagarajan, R., (2016), "Introduction to Industrial Robotics," Pearson Education India, ISBN: 9789332544802


**Reference books:**


1. Groover, M. P., (2016), "Automation, Production Systems, and Computer-integrated Manufacturing," Pearson Education, ISBN: 9789332572492
2. Sandler, B. Z., (1999), "Robotics: Designing the Mechanisms for Automated Machinery," Academic Press/Prentice Hall, ISBN: 9780137816002
3. Tsai, L. W., (1999), "Robot Analysis: The Mechanics of Serial and Parallel Manipulators," Wiley-Interscience, ISBN: 9780471325932
4. Niku, S. B., (2020), "Introduction to Robotics, Analysis, Control, Applications," Wiley, ISBN: 9781119527626
5. Mittle, R., Nagrath, I., (2017), "Robotics and Control," McGraw Hill Education, ISBN: 9780070482937
6. Mike Wilson, M., (2014), "Implementation of Robot Systems: An introduction to robotics, automation, and successful systems integration in manufacturing," Butterworth-Heinemann, ISBN: 9780124047334
7. Spong, M. W., Hutchinson, S., Vidyasagar, M., (2020), "Robot Modeling and Control," Wiley, ISBN: 9781119523994

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII |
|---|---|---|---|---|---|---|
| Course: | Steam Engineering & Energy Conservation (Professional Elective –VI) | | | | | Code: BME7506D/BME8506D |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Engineering Thermodynamics
b. Applied Thermodynamics
c. Fluid Mechanics
d. Heat Transfer…..is essential

**Course Objectives:**

1. To acquaint and make students to understand the fundamentals of steam system in process heating with
2. Special emphasis on the steam and condensate loop and its design.
3. To develop an ability amongst the students to design a steam system and assess its performance
4. To makes the students aware of improvement in the steam system with the perspective of energy conservation.

**Course Outcomes:**

The students will be able to,

1. Apply the basics of steam for utilizing it as a heating medium.
2. Select the type of boiler for process heating application and analyze its performance
3. Select the accessories required for distribution of steam in process heating plant
4. Select suitable controlling and measuring devices.
5. Select suitable steam traps and other accessories necessary for condensate management.
6. Design a steam system for process industry applications with an eye towards energy conservation.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Steam Basics**<br>Introduction, What is steam, formation of steam at constant pressure/ temperature, T-v, P-v, T-s and h-s diagram Steam pressure/temperature relationship, Steam pressure volume relationship, super heated steam, steam as a carrier of heat for process heating, steam distribution pressures, steam quality, heat transfer, flash steam. Properties of steam Use of steam table/Mollier Chart. Heat Exchangers: uses, types and selection. | 7 |
| 2 | **Steam generation**<br>Boilers- Water tube and Fire tube boilers. Boiler Water Treatment - need, types / methodology , Blow-down, Boiler mountings and accessories, Fuels and combustion, Boiler efficiency (direct and indirect method), factors affecting boiler efficiency, Boiler manufacturing. IBR considerations, types of burners. Technological developments in Boilers | 8 |
| 3 | **Accessories and Steam distribution**<br>Piping accessories. Valves (types, selection and characteristics) moisture separators, strainers etc. | 8 |

| | | |
|---|---|---|
| | Steam Distribution. Line sizing, good engineering practices in piping design, water hammer, air venting, insulation etc. | |
| **4** | **Measurements and controls**<br>Control Basics, Control valves and de-superheating, Pressure and Temperature controls. Need, Methods and advantages of Pressure and Temperature Controls. Flow Measurement. Need, Types of Flow meters, applications, advantages and disadvantages. | **7** |
| **5** | **Condensate Management**<br>Trapping and Trap Monitoring. Types of traps, Principles, operation, applications, need of trap monitoring and methods. Modern day Trapping systems Flash steam and Condensate recovery. Flash steam recovery, Condensate Management, Steam operated pumps, Flash vessels, Stalling etc. | **7** |
| **6** | **Energy Conservation and Steam Applications**<br>Steam engineering and energy conservation, Steam Audit, introduction to co-generation. Applications of steam in Process industries like Paper, Textile, Dairy and Hospitality. Performance matrix of steam systems. | **8** |
| | **Total** | **45** |

**Reference books:**


1. M.P. Murgai and W.M Baber, Boiler Operations,1990, New Age International
2. Oliver Lyle, Efficient Use of Steam Vol1 and Vol 2, Her Majesty Stationery Office.
3. L.G. Northcroft, Steam Trapping and Air Venting, 2001, Hutchinson And Company (Publishers) Ltd.
4. Philip Skousen , Valve Handbook, 2003,Mcgraw Hill Companies
5. Rayprolu , Boilers for Power and Process, 2001 CRC Press-Taylor & Francis Group
6. P. Chattopadhyay, Boiler Operation Engineering , 2004, Tata McGraw-Hill Company

| Program: | B. Tech. (Mechanical Engineering) | | Semester: VII/VIII | | |
|---|---|---|---|---|---|
| Course: | Adhesive Technologies (Professional Elective –VI) | | Code: BME7506E/ BME8506E | | |
| Teaching Scheme | | | Evaluation Scheme | | |
| Lecture | Hours | Credit | FA | SA | Total |
| 3 | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Basics of Mechanical Engineering

b. Probability and statistics

c. Basics of Chemistry…….are essential

**Course Objectives:**

1. To impart a basic understanding of adhesives and the bonding process.
2. To make the learner aware of applications of adhesives in improving the reliability of threaded joints and assemblies
3. To be familiar with different dispensing methods.
4. To provide a basic understanding of the shelf life and various failure modes observed in shelf life.
5. To explain the use of test standards and certification processes of ISO 10964, ISO 10123, and ISO 16047.

**Course Outcomes:**

The students will be able to,

1. Use the concept of adhesion and bonding processes in various applications
2. Apply suitable adhesives in threaded joints and assemblies and estimate/ predict its performance.
3. Demonstrate different dispensing techniques and select suitable dispensing techniques.
4. Use a suitable method to estimate the reliability of assembly/ joints.
5. Develop a system reliability model using FMEA/ FTA and identify root causes of the failures.
6. Use test standards and certification processes provided in ISO 10964, ISO 10123, and ISO 16047.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Basics of Adhesives**<br>Introduction, Definition of adhesives, basics of bonding, Adhesion, Cohesion, Bonding process – surface preparation, cleaning, application of adhesive, curing process, performance and testing cured adhesive strength, Effect of Environment on cured bond line;<br>Demonstration / Experimental work. | 8 |
| 2 | **Threaded Assemblies**<br>Threaded fastener mechanics, clamping loads, controlled clamp loads, fastener failures, Thread lockers, application of adhesives, Testing, and validation. Pipe joints; Thread sealing; Retaining for cylindrical assembly;<br>Demonstration / Experimental work. | 7 |
| 3 | **Gasketing and Bonding**<br>Types of gasketing, Materials used for gasketing, Issues with gasketing, adhesive applications for gasketing, Types of bonding, Performance of gasketing with and without application of adhesive bonding. | 7 |

| | | |
|---|---|---|
| | Demonstration / Experimental work. | |
| **4** | **Dispensing**<br>Why dispensing equipment? Dispensing technology – pressure/ time dispensing, volumetric dispensing, peristaltic pump, progressive cavity pump, Manual dispensing, Automatic dispensing, Equipment selection;<br>Demonstration / Experimental work. | **8** |
| **5** | **Troubleshooting**<br>Failure modes, causes, mechanisms, Root cause analysis, Failure mode analysis, Fault tree analysis, Failure modes and effects analysis, Fishbone diagram<br>**Shelf Life:** Definition of shelf life, Failure modes observed, Product performance, Packaging Stabilizer, Estimation of reliability and life of the product, Effect of temperature and humidity on the life;<br>Demonstration / Experimental work. | **8** |
| **6** | **Certification and Standards**<br>Certification organizations, certification processes, test standards, Practical's and experience sharing ISO 10964, ISO 10123, ISO 16047;<br>Demonstration / Experimental work. | **7** |
| | **Total** | **45** |

**Text Books:**

1. LOCTITE Handbook on "How to Increase Reliability and Prevent Threaded Assembly failure", ISBN: 9783941 517769.

**Reference books:**

1. Petrie EM. An Introduction to Adhesive and Sealants. In: Handbook of Adhesives and Sealants. First ed. McGraw-Hill Professional, New York, NY, USA; 1999
2. Ebnesajjad S. Adhesive Technology Handbook. 2nd ed. William Andrew Inc, Norwich, NY, USA; 2008
3. Skeist I, Miron J. Introduction to Adhesives. In: Skeist I, editor. Handbook of Adhesives Boston: Springer; 1990.
4. Reliability Engineering by K. C. Kapur, and M. Pecht, Wiley, 2014.

**List of experiments/ demonstration (Any 8)**

1. Joint strength of a lap joint subjected to tensile load
2. Breakloose strength of various thread locking options and commonly accepted mechanical locking devices
3. Threadlocker in a blind hole and through holes
4. Mechanical locking devices
5. Large nuts and bolts
6. Cured anaerobic
7. Problem/ prevention/ repair
8. Thread sealant pressurized pipe
9. Reliable gasketing
10. Pre-cut gasket
11. Pressurized flange sealing

Note – the experiments/ demonstrations should be done during the lecture hours.

| Program: | B. Tech. (Mechanical Engineering) | | Semester: VII | | |
|---|---|---|---|---|---|
| Course: | Project Stage I (for Scheme C) | | Code: BME7702 | | |
| Teaching Scheme | | | Evaluation Scheme | | |
| Practical | Hours | Credit | TW | OR | Total |
| 12 | 12 | 6 | 100 | 50 | 150 |

**Prior knowledge of:**

a. All the courses

**Course Objectives:**

1. To provide an opportunity of designing and building complete systems or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them get confidence by planning and carrying out the project's work plan and to complete the same through observations, discussions successfully, and the decision-making process.
5. To get visibility in the industry to Project and Project Group

**Course Outcomes:**

After learning the course, the students should be able to

1. **Demonstrate** sound academic fundamentals to formulate and analyze complex Mechanical engineering problems.
2. **Provide creative/ innovative solutions** for complex engineering problems.
3. **Design Mechanical systems/products/processes** for providing solutions to environmental issues/ needs of society/Industry/ safety issues.
4. **Apply** modern modeling and simulation techniques/ computing tools.
5. **Work effectively as a team member / Leader** in order to manage the project work and finance.
6. **Write a report** on the research work and present it effectively.

**Detailed Syllabus:**

The evaluation of project stage 1 will be done considering the performance of students in Reviews 1, 2, and the final examination. For details, kindly refer to the project guidelines.

| Review | Description |
|---|---|
| **1.** | **Project stage 1 Review 1:** This review will be planned at the beginning of semester VII (Within a month of semester commencement). Review 1 will be purely a synopsis presentation, which the DPAC will take. The assessment of this review will be considered for Internal evaluation. Students shall prepare the presentation on selected project ideas according to their area of interest. The brief presentation with the precise aim and objectives of the project shall be presented in front of the DPAC after taking approval from the respective project guide. |
| **2.** | **Project Stage 1 Review 2:** Project Stage 1 Review 2 will be planned after 1 month of review 1. The aim of review 2 is to look into the progress of the student after review 1. The assessment of this review will be considered for Term work evaluation. The DPAC shall check whether the student has answered and compiled the queries raised in review 1. The objective of review 2 is to identify the progress of the student group in line with their methodology planned. The following points can be considered for the Review 2 presentation:<br>o Study of data<br>o Modeling/System Design<br>o Design calculations<br>o Numerical Simulation /Mathematical model<br>o Finalization of design |
| **Final Examination** | **Project Stage 1 Final Examination:** Final Examination will be scheduled after review 2 as per the schedule provided by the examination section. This examination will be carried out under the supervision of the Project guide and appointed External examiner. For the final examination, the student shall complete the project report in all aspects, including formatting. Each Student shall prepare the report duly signed by the project guide, head of the department, director, and external examiner. Along with this, students are required to prepare two extra copies of the project report duly signed by the above-mentioned authorities. Students shall submit all the data related to project work in soft copy to their guides, including project reports, Presentations, CAD and CAE files, etc. |

# Course Syllabus

## Open Elective Courses

## Semester-VII

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII/ VIII | | |
|---|---|---|---|---|---|---|
| Course : | Cloud Computing (Open Elective-V) | | | Code : BIT7601/ BIT8601 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Computer Networks Basics is essential.

**Course Objectives:**

1. To learn the concept of cloud computing.
2. To have knowledge on the various issues in cloud computing
3. To appreciate the emergence of cloud as the next generation computing paradigm.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Explore the basic terminologies in cloud computing
2. Describe cloud delivery models with examples
3. Illustrate cloud enabling technology
4. Discuss hardware and infrastructure requirements
5. Administer/determine cloud security mechanisms
6. Examine common standard in cloud computing

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Understanding Cloud Computing:** Origin and Influences- History, definitions, technology innovations; Cloud Computing terminologies, Applications, benefits and limitations, risk and challenges; Roles and Boundaries, Cloud characteristics, Cloud Delivery Models, Deployment Models. | 8 |
| 2. | **Cloud Service Types:** Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services, Service providers: Google App Engine, Microsoft Azure Service Platform, Amazon EC2, Salesforce, IBM. | 8 |
| 3. | **Cloud Enabling Technology:** Broadband Networks and Internet Architecture, Data centre technology, virtualization technology, Web technology, Multitenant technology, Service Technology. | 8 |
| 4. | **Hardware and Infrastructure:** Clients- mobile, thin, thick; Security- data leakage, offloading work, logging, forensics, development, auditing; Network-basic public Internet and accelerated Internet; Services- Identity, Integration, Mapping, Payments, Search. | 8 |
| 5. | **Cloud Security:** Basic Terms and concepts-Confidentiality, Integrity, Authenticity, availability, Threat, Vulnerability, Risk, Security Control, Security Mechanisms, Security Policies. | 7 |
| 6. | **Common Standards in Cloud Computing:** Open Cloud Consortium- Open Virtualization Format, Standards for Application Developers- browsers, data and solution Stack; Standards for Messaging- SMTP, POP, IMAP, RSS, HTTP; Standards for Security- Security (SAML OAuth, OpenID, SSL/TLS). | 6 |
| | **Total** | 45 |

**Text Books:**


1. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", Pearson May 2013, ISBN: 9780133387568.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill,
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press,


**Online Material :**

1. NPTEL Course on Cloud Computing : https://nptel.ac.in/courses/106105167
2. Google Cloud Computing Foundation Course: https://nptel.ac.in/courses/106105223

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII/ VIII | | |
|---|---|---|---|---|---|---|
| Course : | Data Science for Engineers (Open Elective –VI) | | | Code : BIT7602/ BIT8602 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Database Management

b. Data mining…….are essentials**.**

**Course Objectives:**

1. To learn the basics and process of Data Science.
2. To introduce the mathematical foundations required for Data Science.
3. To use Optimization techniques to obtain best solution.
4. To demonstrate patterns in data through a variety of statistical modeling.
5. To identify the strength of predictors, forecast an effect, a trend in data.
6. To classify data into a given number of classes to provide predictions.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Describe a flow process for Data Science problems.
2. Differentiate mathematical foundations required for Data Science.
3. Use Optimization to obtain best solution.
4. Demonstrate patterns in data through a variety of statistical modeling.
5. Identify the strength of predictors; forecast an effect, a trend in data.
6. Classify Data Science problems into standard topology.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction**<br>Definition – Big Data and Data Science, Hype, Need of Data Science, Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration , Data modeling, Introduction to R, Advanced Programming in R, Data visualization in R Basic graphics. | 7 |
| 2. | **Linear Algebra for Data Science**<br>Solving Linear Equations, Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors. | 8 |
| 3. | **Optimization for Data Science**<br>Introduction, unconstrained multivariate optimization, Gradient (Steepest) Descent (OR) Learning Rules, Multivariate Optimization With Equality Constraints, Multivariate Optimization With Inequality Constraints. | 8 |
| 4. | **Statistical Modeling for Data Science**<br>Event Space, Random variable, Probability density function, Distributions and Hypotheses Testing. | 6 |

| | | |
|---|---|---|
| **5.** | **Regression for Data Science**<br>Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multi collinearity, Polynomial Regression, Cross Validation, Simple Linear Regression Model Building and assessment, Predictive Modelling, Dataset. | **8** |
| **6.** | **Classification for Data Science**<br>Logistic regression, K - Nearest Neighbors (kNN) and k-means clustering, Naive Bayes, Discriminant Analysis, K - Nearest Neighbors implementation in R, K - means implementation in R, Performance Measures. | **8** |
| | **Total** | **45** |

**Text Books:**

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", , Manning Publications Co., 1st edition, 2016
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani., "An Introduction to Statistical Learning: with Applications in R", , Springer, 1st edition, 2013

**Reference Books:**

1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets. v2.1", Cambridge University Press, 2014
2. Joel Grus, "Science from Scratch: First Principles with Python", O'Reilly, 1st edition, 2015
3. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013
4. Kalyanmoy, Deb. "Optimization for engineering design: Algorithms and examples", Prentice-Hall of India Pvt. Limited, 2012.

**Online Courses:**

1. Coursera Course on "What is Data Science?" offered by IBM. Available at https://www.coursera.org/learn/what-is-datascience?specialization=ibm-data-science
2. NPTEL Course on "Data Science for Engineers" offered by IIT, Madras. Available at https://onlinecourses.nptel.ac.in/noc21_cs69/preview

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII |
|---|---|---|---|---|---|---|
| Course: | Web Technology and its Applications (Open Elective –V) | | | | | Code: BCE7607/BCE8607 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. www- world wide web, HTML is essential.

**Course Objectives:**

1. To understand the basics of Web Designing using HTML, CSS and JavaScript
2. To learn the basics about Client side scripts
3. To learn the basics about Client side framework.
4. To understand the web services and frameworks.

**Course Outcomes:**

After learning the course, students will be able to:

1. Elaborate the behavior of web pages using HTML.
2. Demonstrate the client-side technologies for media in web development.
3. Illustrate the client-side technologies for design/layout in web development.
4. Apply the scripting language for web development.
5. Apply server-side technologies for web development.
6. Use dynamic web applications for advanced web development platforms.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Web Essentials and Mark-up language- HTML**<br>HTML- Basics, List, Tables, Images, Forms, Frames.<br>Designing a webpage in HTML for displaying Boiler readings/ displaying oscilloscope readings/ displaying building plans, etc. | 7 |
| 2. | **HTML Media and API**<br>HTML: Media, Video, Audio, YouTube, GeoTag, Drag and Drop.<br>Creating a Web Page and inserting video/audio with controls and AutoPlay.<br>Designing a webpage in HTML displaying the location of your device/ place consisting of GPS. | 8 |
| 3. | **Client Side Technologies-CSS**<br>Introduction to cascading style sheets. Inserting CSS in an HTML page, CSS selectors.<br>**Advanced CSS -** Round Corners, Boundary Images, Gradients, Shadows, 2D and 3D transformations.<br>Designing a layout for any application such as displaying readings for an oscilloscope (or any example of your domain). | 7 |

| | | |
|---|---|---|
| **4.** | **Client Side Technologies-XML and JavaScript**<br>XML- Document type definition, XML Schemas, Document Object model. Java Script -Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script.<br>Designing a calculator using JavaScript. | **7** |
| **5.** | **Server Side Scripting Languages**<br>PHP-Origins and Uses of PHP, Overview of PHP and General Syntactic Characteristics, Primitives, Operations, and Expressions, Output and Control Statements, Arrays, Functions, Basic Pattern Matching, Form Handling, Files Handling, Cookies. | **8** |
| **6.** | **Current Trends in Web Technology**<br>**Progressive Web Apps**- Case Study FlipBorad, 2048 Game, SoundSlide, **Single-page applications (SPA)** – AngularJS, ReactJS, Vue.js, example- Youtube, Chatbots and virtual assistants, Responsive design, Cloud-based development and deployment | **8** |
| | **Total** | **45** |

**Text Book:**


1. Brown, Ethan, “Web Development with Node and Express: Leveraging the JavaScript Stack”, O'Reilly Media, 2019.
2. HTML5 Canvas: Native Interactivity and Animation for the Web, 2 nd edition, Steve Fulton, Jeff Fulton · 2013.
3. Web Technologies: HTML, Javascript, Php, Java, Jsp, Asp.Net, Xml And Ajax, Black Book-2009.
4. Achyut Godbole & Atul Kahate :Web Technologies TCP/IP, Web/Java Programming, and Cloud Computing- 2013.
5. Dom Scripting: Web Design with Javascript and the Document, 2nd Edition, Jeremy Keith, Jeffrey Sambells · 2011.


**Reference Books:**


1. Adam Bretz & Colin J Ihrig, “Full Stack Javascript Development with MEAN”, SPD, ISBN-13: 978-0992461256,2014
2. Giulio Zambon, “Beginning JSP, JSF and Tomcat”, Apress Publication, ISBN-10:1430246235; ISBN-13: 978-1430246237,2012.
3. Jeremy McPeak& Paul Wilton,” Beginning JavaScript”, Wrox Publication, ISBN-13: 978-0470525937,2012
4. Robin Nixon, “Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5”, O’REILLY, ISBN: 13:978-93-5213-015-3, 2014.


**Web references:**

1. https://www.w3.org/html/
2. HTML, The Complete Reference http://www.htmlref.com/
3. http://w3schools.org/
4. http://php.net/
5. https://jquery.com/
6. http://www.tutorialspoint.com/css/
7. https://www.simicart.com/blog/progressive-web-apps-examples/
8. http://www.nptelvideos.in/2012/11/internet-technologies.html
9. https://freevideolectures.com/course/2308/internet-technology/25 video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
10. https://www.digimat.in/nptel/courses/video/106105191/L01.html
11. http://www.nptelvideos.com/php/php_video_tutorials.php

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Software Testing & Quality Assurance (Open Elective –V) | | | | | Code: BCE7608/ BCE8608 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Software engineering basics is essential.

**Course Objectives:**

1. To study and understand the software development life cycle.
2. To introduce basic concepts of software testing
3. To understand white box, block box, automation and other testing techniques
4. To understand the software quality processes and management.

**Course Outcomes:**

After learning the course, students will be able to:

1. Understand the software development life cycle.
2. Comprehend the software testing basic concepts and terminologies.
3. Demonstrate the different testing types.
4. Demonstrate understanding of automation testing.
5. Outline the test planning and management process.
6. Elaborate the different Software Quality techniques and tools.

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Software Development Life Cycle Models** Phases of Software Project, Quality, Quality Assurance, and Quality Control Testing, Verification, and Validation Process, Model to Represent Different Phases, Life Cycle Models | 7 |
| 2. | **Introduction to Software Testing** Goals Of Software Testing, Model for Software Testing, Effective Software Testing Vs. Exhaustive Software Testing, Software Testing As A Process, Software Testing Terminology Definitions | 7 |
| 3. | **Types of Testing** White Box Testing, Static Testing, Black Box Testing, requirement of Black Box Testing, when to do Black Box Testing? Integration Testing, System Testing requirement of System Testing, Challenges in testing. Software Failure case studies (any two) | 8 |
| 4. | **Introduction to test automation** Terms Used in Automation, Skills Needed for Automation, What to Automate, Scope of Automation, Design and Architecture for Automation, Process Model for Automation, Selecting a Test Tool, Challenges in Automation | 8 |
| 5. | **Test Planning and Management** Introduction, Test Planning, Test Management, Choice of Standards, Test Infrastructure Management, Test Process, Test cases & test plan preparation | 8 |
| 6. | **Software Quality Management** Software Quality, Broadening the Concept Of Quality, Quality Control And Quality Assurance, Methods Of Quality Management, Software Quality Metrics, SQA Models | 7 |
| | **Total** | 45 |

**Text Book:**

1. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing: Principles and Practices”, Pearson, 2017.
2. Naresh Chauhan, “SOFTWARE TESTING Principles and Practices”, OXFORD UNIVERSITY PRESS, 2nd edition 2016

**Reference Books:**

1. Paul Ammann, Jeff Offutt, “Introduction to Software Testing”, Cambridge University Press, Dec 2016.
2. Ilene Burnstein, “Practical Software Testing A Process-Oriented Approach”, Springer-Verlag New York, Inc., 2006 ISBN 0-387-95131-8

**Web References:**

1. https://pdfcoffee.com/download/se-4-pdf-free.html

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII /VIII | |
|---|---|---|---|---|---|---|
| Course: | MOOC (Open Elective –V) | | | | Code: BCE7609 / BCE8609 | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | Certification Exam | Total |
| - | - | - | 3 | 70 | 30 | 100 |

**Prior knowledge of:**

a. As mentioned in MOOC

**Course Objectives:**

1. MOOC courses are introduced to imbibe self learning in students.
2. To prepare students for modern tools and techniques.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Inculcate Self learning.
2. Explore modern tools and techniques.

**Guidelines for Students:**

1. Individual students need to select MOOC course as OEC-6.
2. Students should select MOOC from the NPTEL online platform only.
3. Selected MOOC course should be of 12 weeks.
4. Individual students should check that the selected course is not similar to the courses studied in earlier semester.
5. Students must take prior approval from Mentor and MOOC coordinator through the prescribed form given in Annexure-5.
6. Students must submit proof of course registration done in NPTEL along with Annexure-5.
7. Students must complete all assessments related to the selected course as prescribed by the course in NPTEL.
8. After the completion of the course, students shall be required to submit the photocopy of completion certificate showing marks obtained to the department for earning the required credits.

**Guidelines for Mentor and MOOC Co-ordinator:**

1. Mentor and MOOC Coordinator shall check content of the NPTEL course for applicability/importance/ relevance etc to the student and then recommend the course.
2. Mentor and MOOC Coordinator shall check that selected course is not similar to the courses studied in earlier semester.

**Web references:**

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

**Annexure 5**: MOOC Course Approval Form

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII | | |
|---|---|---|---|---|---|---|
| Course: | Database Management System (Open Elective –VI) | | | Code: BCE7610 /BCE8610 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Mathematics is essential.

**Course Objectives:**

1. To understand the fundamental concepts of database management.
2. To provide a strong formal foundation in database concepts, technology, and practice.
3. To make students familiar with building good database design.
4. To learn different SQL queries and concepts.

**Course Outcomes:**

After learning the course, students will be able to:

1. Understand the fundamental concepts of database management systems.
2. Design E-R Model for given requirements and convert the same into database tables.
3. Design schema in appropriate normal form considering actual requirements.
4. Write SQL queries to perform basic operations on tables in the database.
5. Write DML SQL queries for a given database.
6. Write SQL queries to perform operations on different database objects

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database System Structure. | 7 |
| 2. | Data Models, Database Design, Entity Relationship Model, ER Diagram, Extended ER diagram, converting E-R and Extended ER diagram into tables. | 7 |
| 3. | Relational Model: Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF. | 7 |
| 4. | Database Languages DDL, DML, SQL: Characteristics and advantages, SQL Data Types, SQL Operators, Tables: Creating, Modifying, Deleting, Updating.<br>Demonstration and practice of DDL and DML queries in Oracle | 8 |
| 5. | SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL, SQL - Ordering of Tuples, Aggregate Functions, SQL Functions, Synonym.<br>Demonstration and practice of DDL and DML queries in Oracle | 8 |
| 6. | SQL Views: Creating, Dropping, Updating using Indexes, Set Operations, Joins, Set membership, Nested Queries. Introduction to PL/SQL.<br>Demonstration of DDL and DML queries in Oracle | 8 |
| | **Total** | 45 |

**Text Book:**


1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020, ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.


**Reference Books:**


1. Coronel, C. and S. Morris, “Database Systems: Design, Implementation, & Management,” 12th edition, Cengage, 2016
2. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009, ISBN 9788177585674


**Web References:**

1. http://w3schools.org/

**MOOC Courses:**

1. Data Base Management System - https://nptel.ac.in/courses/106105175

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII / VIII | | |
|---|---|---|---|---|---|---|
| Course: | Introduction to Blockchain (Open Elective –VI) | | | Code: BCE7611 / BCE7611 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Information Security is essential.

**Course Objectives:**

1. To explain basic components of a Block chain, its operations, underlying algorithms, and essentials of trust
2. To provide the fundamental cryptographic base for Block chain.
3. To make students familiar with the working of Smart Contracts
4. To provide a detailed understanding of workings of a block chain, its transactions, blocks and mining.

**Course Outcomes:**

After learning the course, students will be able to:

1. Comprehend the fundamental characteristics of Block chain.
2. Relate the basic cryptographic primitives essential for Block chain.
3. Compare and contrast the private and public Block chain.
4. Select and apply appropriate distributed consensus algorithms for the real life problem.
5. Analyze the working of Smart Contracts for verification or execution of agreement.
6. Identify relative application where block chain technology can be effectively used and implemented.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction to Block chain**<br>Introduction to decentralized system, History, Conceptualization, Architectural principles behind Block chain, Characteristics of Block chain. | 7 |
| 2. | **Basic Crypto Primitives**<br>Structure of Block, Merkle Tree and Merkle Root in a Block, Symmetric and Asymmetric Encryption, Digital Signature, Hashing, public key cryptosystems, Mining strategy. | 7 |
| 3. | **Types of Block chains**<br>Permission less, Permissioned, Consortium, Hybrid Block chain, Block chain protocol and use cases, Introduction to Bitcoin Block chain, Layers of Block chain: Application Layer Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer | 8 |
| 4. | **Distributed Consensus:** Consensus approach, Consensus elements.<br>**Consensus Algorithms:** Proof of Work, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn, Proof of Authority, Paxos, RAFT Consensus Byzantine General problem, Practical Byzantine Fault Tolerance | 8 |
| 5. | **Smart Contracts and Ethereum**<br>History, Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. Consensus in Ethereum, scripts in Ethereum. Developing and executing smart contracts in Ethereum. | 7 |
| 6. | **Prominent Block chain Applications**<br>Retail, Banking and Financial Services, Government Sector, Healthcare and IOT, Energy and Utilities, Block chain Integration with other Domains | 8 |
| | **Total** | 45 |

**Text Books:**


1. Artemis Caro, “Block chain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency”, Kevin Wolhuter, 2021, ISBN: 1922590061, 9781922590060
2. Mark Watney, Block chain for Beginners: The Complete Step by Step Guide to Understanding Block chain Technology”, Create Space Independent Publishing Platform, 2017, ISBN: 1548766887, 9781548766887


**Reference Books:**


1. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O'Reilly Media, Inc.2017, ISBN: 9781491954386
2. Alwyn Bishop, “Block chain Technology Explained”, Create Space Independent Publishing Platform, 2018, ISBN: 9781986273800


**Web References:**

1. NPTEL Course “Introduction to Block Chain Technology & Applications” https://nptel.ac.in/courses/106/104/106104220/
2. NPTEL Course on “Block chain Architecture & Use Cases” https://nptel.ac.in/courses/106/105/106105184/

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII /VIII |
|---|---|---|---|---|---|---|
| Course: | Android App Development with Kotlin (Open Elective –VI) | | | | | Code: BCE7612 /BCE8612 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Basic programming knowledge (Preferably Java or any other object-oriented language) is essential.

**Course Objectives:**

1. To explore the Kotlin programming language features and scripts.
2. To differentiate between kotlin and java as OOP concepts.
3. To learn the fundamentals of writing Kotlin scripts.
4. To elaborate on the Network and Data Handling Techniques.
5. To learn the advanced Android features.
6. To develop an android application with all features.

**Course Outcomes:**

After learning the course, students will be able to:

1. Differentiate the data types,variables in kotlin.
2. Explore the object oriented programming concepts with Looping.
3. Demonstrate the android studio development environment.
4. Apply the Network and Data Handling Techniques.
5. Illustrate the Advance Android application development features.
6. Deploy the Android application with testing.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction to Kotlin and Android Studio:** Introduction to Kotlin programming language, Setting up the Android Studio development environment, Kotlin syntax and basic programming concepts, Variables, data types, and operators in Kotlin. | 7 |
| 2. | **Kotlin Fundamentals and Object-Oriented Programming with Kotlin :** Conditional statements (if, when), Loops (for, while, do-while), Functions, parameters, and return types Kotlin collections: arrays, lists, and maps, Classes and objects, Properties, fields, and methods, Inheritance, polymorphism, and interfaces, Data classes and sealed classes | 8 |
| 3. | **Android Basics and User Interface, Components and Navigation :** Understanding Android architecture, Activities, intents, and the activity lifecycle, Designing UI with XML and Kotlin, Working with views, view groups, and layouts, Fragments and their lifecycle, Navigation and passing data between fragments, RecyclerView and ListView, Android storage options: Shared Preferences, Files, and Databases | 8 |
| 4. | **Networking and Data Handling :** Working with RESTful APIs and JSON data, Using Retrofit and OkHttp for network communication, Implementing LiveData and ViewModel, Basic understanding of Coroutines for asynchronous programming | 8 |
| 5. | **Advanced Android Features:** Notifications and Pending Intent, Location and Google Maps integration, Permissions and runtime permission handling, Material Design components and theming | 7 |
| 6. | **Testing, Debugging, and Deployment :** Unit testing and UI testing with JUnit and Espresso, debugging tools and techniques in Android Studio, Optimizing app performance and memory management, Preparing and publishing your app to Google Play Store | 7 |
| | **Total** | 45 |

**Text Books:**

1. Programming Android with Kotlin by Pierre-Olivier Laurence, Amanda Hinchman-Dominguez, Mike Dunn, G. Blake Meike, ISBN:9781492063001, Publisher: O'Reilly Media, Inc. (December 2021)
2. Beginning Android Development With Kotlin,Publisher: Greg Lim,2020 ISBN:9811477973, 9789811477973

**Reference Books:**

1. Android application development with Kotlin by Trivedi Hardik, Publisher: BPB Publications (12 May 2020)
2. Kotlin and Android Development featuring Jetpack: Build Better, Safer Android Apps by Michael Fazio Publisher: Pragmatic Bookshelf (July 2021)

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII / VIII | | |
|---|---|---|---|---|---|---|
| Course: | Agile Project Management (Open Elective –VI) | | | Code: BCE7613/ BCE8613 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Software Engineering is essential.

**Course Objectives:**

1. Learn to create a framework of Agile Project Management for a project.
2. To understand the Agile project communication and team building.
3. To learn the Agile Retrospectives for planning and monitoring a project.
4. To learn the Agile project analysis and design.
5. To learn how to use the tools that allow taking advantage of an Agile project environment.
6. To get aquatinted with capabilities and knowledge in Agile Project Management.

**Course Outcomes:**

After learning the course, students will be able to:

1. Explore the framework for agile project communication
2. Elaborate the agile retrospectives for planning and monitoring of agile project
3. Apply the techniques for Agile project estimation.
4. Build the Agile stories for project management
5. Apply the verification and validation for Agile project
6. Adopt Soft skills negotiation practices.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction to Agile project communications**<br>Introduction, Definition of Agile, Difference between Agile and other methodologies, Agile Principles. Agile Information radiator, Agile Team space, Agile tooling, Osmotic communications for collocated teams, Osmotic communications for distributed teams, Agile Daily stand-ups, **Case Study:** IT service delivery centre | 7 |
| 2. | **Creating High-Performance Team**<br>Build A Team, Define Team Ground Rules, Negotiate Project Agreements, Empower Team Members and Stakeholders, Train Team Members And Stakeholders, Engage And Support Virtual Teams, Build Shared Understanding About A Project, **Case Study**: Creating High Performance Team Leadership | 8 |
| 3. | **Project Planning**<br>Determine Appropriate Project Methodology/Methods And Practices, Plan And Manage Scope, Plan And Manage Budget And Resources, Plan And Manage Schedule, Plan And Manage Quality Of Products And Deliverables, Integrate Project Planning Activities, Plan And Manage Procurement, Establish Project Governance Structure, Plan And Manage Project/Phase Closure, **Case Study:** Virtual Research Environment Development Project | 7 |

| | | |
|---|---|---|
| **4.** | **Monitoring and Adopting**<br>Introduction, Agile Retrospectives, Agile task and Kanban boards, Scrum, Agile Timeboxing, Agile Iteration and release planning, Agile WIP limits, Agile Burn down/up charts, Agile cumulative flow diagrams, Agile process tailoring **Case Study:** Management of a Multidisciplinary Research Project | **7** |
| **5.** | **Assess and Manage Risks**<br>Assess and Manage Risks, Execute Project To Deliver Business Value, Manage Communications, Engage Stakeholders, Create Project Artifacts, Manage Project Changes, Manage Project Issues, Ensure Knowledge Transfer For Project Continuity, **Case Study:** Agile Risk Management Process in Multiple Projects Environments | **8** |
| **6.** | **Agile analysis and design**<br>Introduction, Agile product roadmap, Agile user stories and backlog, Agile story maps, Agile progressive elaboration, Agile wireframes, Agile chartering, Agile personas, Agile modeling, Agile estimation: Agile relative sizing/story points, Agile wide band Delphi, Agile planning poker, **Case Study:** project management in a multidisciplinary production environment | **8** |
| | **Total** | **45** |

**Text Books:**


1. Layton, Mark C., Steven J. Ostermiller, and Dean J. Kynaston. Agile project management for dummies. John Wiley & Sons, 2020.
2. Mesjasz, Czesław, Katarzyna Bartusik, Tomasz Małkus, and Mariusz Sołtysik. Agile Project Management and Complexity: A Reappraisal. Routledge, 2022.
3. Ajam, Mounir. Project management beyond waterfall and agile. CRC Press, 2018


**Reference Books:**


1. Adkins, Lyssa. Coaching agile teams: a companion for ScrumMasters, agile coaches, and project managers in transition. Pearson Education India, 2010.
2. Verma, Rahul. "Agile Project Management: Experience and Adoption." In Contemporary Challenges for Agile Project Management, pp. 44-51. IGI Global, 2022.
3. Chatterjee, Sheshadri, Ranjan Chaudhuri, Demetris Vrontis, Alkis Thrassou, and Soumya Kanti Ghosh. "Adoption of artificial intelligence-integrated CRM systems in agile organizations in India." Technological Forecasting and Social Change 168 (2021): 120783.
4. Stellman, Andrew, and Jennifer Greene. Learning agile: Understanding scrum, XP, lean, and kanban. " O'Reilly Media, Inc.", 2014


**MOOCs Courses link:**

1. https://archive.nptel.ac.in/courses/110/104/110104073/
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/agile-testing-methodology-and-project-management-test-automation/

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII | | |
|---|---|---|---|---|---|---|
| Course: | E- Waste Management (Open Elective-V) | | | Code: BCI7605A/ BCI8605A | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Fundamentals of Environmental Engineering.

b. Fundamentals of Sustainable Engineering…….are essential

**Course Objectives:**

1. To impart knowledge of e-waste in Indian and Global scenarios and role of engineering in e-waste management.
2. To build the concept of the role and responsibility of different stakeholders in the e-waste business.
3. To make aware of e-waste legislation (Acts and guidelines)
4. To get acquainted with recycling and recovering technologies.
5. To create awareness on e-waste global trade.
6. To impart knowledge of the circular economy and e-waste for a sustainable future.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Identify the issues and challenges of e-waste management for a sustainable environment.
2. Explain the role and responsibilities of stakeholders and directory bodies for e-waste control measures.
3. Explain legislation (Acts and guidelines) and apply sustainable approaches.
4. Identify the e-waste handling process, recycling, and recovery techniques for a sustainable future.
5. Explain e-waste global trade and economy.
6. Apply a circular economy road map for an e-waste sustainable future.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to Electronic and Electrical Waste (e-Waste)**<br>What is E-Waste, Indian and global scenario of e-Waste, Growth of the Electrical and Electronics industry in India and global, Composition and characteristics of e-waste, e-waste pollutants, Possible hazardous substances present in e-waste, Environmental and Health implications-waste disposal issues and challenges for domestic and commercial, Awareness and approach towards E-waste, Role and responsibility of engineering in e-waste management Case Study. | 7 |
| 2 | **Electronic and Electrical Waste (e-Waste) control measures**<br>Need for stringent health safeguards and environmental protection laws in India, Regulatory compliance including roles and responsibilities of different stakeholders, Proposed reduction in the use of hazardous substances(RoHS), Extended Producer's Responsibility (EPR) targets Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source. Case Study. | 7 |
| | **E-waste Legislation** | 7 |

| | | |
|---|---|---|
| **3** | The regulatory regime for e-waste in India, Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016, e-waste (Management) Amendment Rules, 2018, 2022 .A comprehensive analysis of e-waste legislation worldwide. International Conventions, Regulations and Laws, handling e-waste in developed and developing countries: initiatives, practices, and consequences with a case study. G20 summit 2023. | |
| **4** | **Electronic and Electrical Waste (e-Waste) Management**<br>Basic principles of e-waste management, Technologies for segregation and recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India. Reuse of E-waste. Carbon footprint and credits for recycling, Case study on recycling and recovering technology. | **8** |
| **5** | **E-waste hazards on Global trade**<br>Essential factors in the global e-waste trade economy, e-waste trading as a quintessential part of electronic recycling, free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India with case study. | **8** |
| **6** | **Circular economy and e-waste**<br>Sustainable management of e-waste and circular economy, Achieving UN Sustainable Development Goals (SDGs) and E-Waste, Urban mining towards sustainable future and circular economy, Entrepreneurship and expertise in e-waste, global challenges and opportunities in structured e-waste management. Circular electronics roadmap, Circular economy startup in India with a case study. | **8** |
| | **Total** | **45** |

**Text Books:**

1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, Latest edition
2. Electronic Waste Management: Edition 2, by G H Eduljee, R M Harrison, Royal Society of Chemistry 2022, ISBN 978-1-78801-744-2
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

**Reference Books:**

1. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017 Elsevier

**E-Resources**

1. https://cpcb.nic.in/e-waste/
2. https://courses.iid.org.in/course/e-waste-recycling-business
3. https://www.suritex.co.in/
4. http://greenscape-eco.com/
5. https://onlinecourses.nptel.ac.in/noc20_ce12/preview
6. https://nielit.gov.in/gangtok/content/paid-course-e-waste-management

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII / VIII |
|---|---|---|---|---|---|---|
| Course: | Advanced Instrumentation in Infrastructural Engineering (Open Elective-V) | | | | | Code: BCI7605B/ BCI8605B |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Knowledge of fundamentals of Infrastructure engineering

b. Knowledge of fundamentals of geotechnical and transportation engineering…….are essential

**Course Objectives:**

1. To impart knowledge of advanced instruments used in Road Infrastructure
2. To Identify the advancement in various modes of transportation
3. To make aware of the scope of various instruments in monitoring fields.
4. To get acquainted with sensors and transducers.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Elaborate the role of various agencies involved in building road infrastructure and allied areas
2. Explain different attributes related to urban transportation
3. Analyze the various tools and measures to delineate with the traffic conflicts in an urban city
4. Determine the properties of soils using various advanced instruments.
5. Apply the knowledge of instruments in various monitoring fields.
6. Discover the additional attributes in advanced sensors and their role in Civil Engineering.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Pavement Infrastructure**<br>Introduction to pavement infrastructure, Types of pavement (Flexible, Rigid and Composite), IRC (Indian Roads Congress)and MoRTH (Ministry of Road Transport and Highways) guidelines, Role of National Highway Authority of India in pavement construction, Advanced Instrumentation in Pavement construction, Modern Modes of Transportation (Road, Rail, Air and Water transportation) | 7 |
| 2 | **Urban Public Transportation**<br>Urban growth and public transport needs – Transit mode classifications -Transit characteristics- Demand estimation- Frequency & Fleet size determination, Advanced Survey Instruments<br>Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design.<br>Types of Road Markings,Traffic Impact Attenuators, Safety Barriers, Traffic signals: types and principles of phasing | 9 |
| 3 | **Traffic Monitoring and Control**<br>Traffic Studies: Basic characteristics of Traffic, Volume, Speed and Density, Traffic Volume studies, | 6 |

| | | |
|---|---|---|
| | Speed and Delay studies, Accident Studies and road safety auditing, Traffic calming measures and modern traffic control devices | |
| **4** | **Soil properties using advanced instruments**<br>Pore pressure measurement, Earth pressure cell, Settlement gauges. Inclinometers, Stress measurements, Seismic measurements. Advanced instrumentation in Earthquake resistant structures | **7** |
| **5** | **Scope of Geotechnical Instruments In Various Monitoring Fields**<br>Dam Monitoring Solutions-Water level, Water pressure and seepage, Lateral ground movement, Deformation, Displacement, Stress, Strain, Load Temperature, Tilt, Surface Settlement. Tunnel Monitoring Solutions- Lateral ground movement, Deformation, Displacement, Stress, Strain, Load, Temperature Tilt, Surface Settlement. Structural Monitoring Solutions- Tilt Monitoring, Crack Monitoring, Settlement Monitoring, Lateral Ground Movement, Temperature Monitoring, Pore Pressure Monitoring. | **8** |
| **6** | **Sensors & Transducer:**<br>Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Infrastructural Engineering. | **8** |
| | **Total** | **45** |

**Text Books:**


1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
3. 3.ChakrobortyP.,DasN.,Principlesof Transportation Engineering(2nd edition),PHI,NewDelhi,2017
4. Handbook of Geotechnical Investigation and Design Tables, Routledge, 2007.
5. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
6. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.


**Reference Books:**


1. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication
2. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2010
3. Geotechnical Investigation Methods: A Field Guide for Geotechnical Engineers. EHUNT, Taylor & Francis, .2006.
4. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 5th edition, 2005.
5. IRC and MoRTH standards

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII /VIII | |
|---|---|---|---|---|---|---|
| Course: | 3-D Printing Technique for Construction (Open Elective-VI) | | | | Code: BCI7606A/ BCI8606A | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Computer Aided Design & Drafting.

b. Engineering Materials, Strength of Material

c. Properties of Concrete…….are essential

**Course Objectives:**

After Completing this course, student will be able to:

1. To gain knowledge and skills related to 3D printing technologies.
2. To understand the various software tools, process, material and techniques for construction technology.
3. To apply these techniques into civil Engineering applications like Building, Bridge, wall element, roof ceiling and decorative building elements.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Develop CAD models for 3D printing.
2. Process software files
3. Optimize concrete mix
4. Analyze behavior for strength and challenges in printing
5. Design Mechanism and nozzle
6. Identify defects in post process of printing

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **3D Printing (Additive Manufacturing)**<br>Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications.<br>**CAD for 3D Manufacturing**<br>CAD Data formats, Data translation, Data loss, STL format. | 7 |
| 2 | **3D Techniques**<br>Stereo- Lithography, Laminated Object Manufacturing (LOM), Fused deposition modeling (FDM), Selective laser sintering (SLS), Selective laser melting (SLM), Binder Jet technology. Processing of software file, Process parameter, Process Selection for various applications, | 7 |
| 3 | **Material Properties**<br>Properties of concrete ingredient like cement, sand, fly ash, silica fume, fibers, Concrete Mix proportioning and optimization considering admixtures like super plasticizer, retarders, water reducing agents, quick setting agent etc, viscosity modifying agents, geo-polymers, fibers, alternative material used | 7 |

| | | |
|---|---|---|
| | for printing, | |
| **4** | **Material Testing & Behavior**<br>Testing on material like compressive strength, bonding strength, workability, setting time, build ability, flow ability, etc, Structural behavior and its Integrity. Challenges like problems of aggregate jamming in the nozzle, compacting obstacles, and the spacing limitations due to rebar and formwork installation. | **8** |
| **5** | **Equipment Mechanism**<br>Process Equipment- Design and process parameters, Nozzle design and optimization like shape, diameter, piston type or screw type. Process Design-synchronization of components | **8** |
| **6** | **Post Processing:** Requirement and Techniques, Support Removal, Finishing treatment, polishing<br>**Product Quality:** Inspection and testing, Defects and their causes | **8** |
| | **Total** | **45** |

**Text Books:**

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Lan Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. 3D Printing and Rapid Prototyping- Principles and Applicationsby CK Chua, Kah Fai Leong,World Scientific, 2017.
3. 3D Printing and Design by Hanser Publisher, Khanna Editorial, Khanna Publishing House, Delhi, 2011.
4. Concrete Technology: Theory and Practice byM. S. Shetty & A K Jain, S. Chand Publication, 2019.

**Reference Books:**

1. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”.

**E Resources:**

1. 3D Printing and Additive Manufacturing Specialization

   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
2. 3D Printing Software’,Jeffrey Smith, Education Manager, Coursera Course by University of Illinois at Urbana-Champaign, USA.

   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. 3D Printing Applications’,Vishal Sachdev Clinical Assistant Professor , Director, Illinois MakerLab, Coursera Course ,University of Illinois at Urbana-Champaign, USA.

   https://www.coursera.org/learn/3d-printing-applications

| Program: | B. Tech. (Mechanical Engineering) | | | | Semester: VII / VIII | |
|---|---|---|---|---|---|---|
| Course: | Structural Health Monitoring & Audit (Open Elective-VI) | | | | Code: BCI7606B/ BCI8606B | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Knowledge of Concrete Technology is essential.
b. Knowledge of Rehabilitation and Retrofitting of Structures……..are essential

**Course Objectives:**

1. To impart knowledge of diagnosis the distress in the structure, its causes and factors.
2. To assess the health of structure using static field methods and dynamic field methods.
3. To introduce the repairs and rehabilitation measures of the structure.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Understand the deterioration and distress in structures.
2. Evaluate causes and prevention methods for structural health monitoring.
3. Understand Simulation and Loading Methods in static field.
4. Analyze Data Acquisition Systems in dynamic field testing methods.
5. Understand piezo– electric materials and other smart materials in structural health monitoring.
6. Apply the knowledge of NDT techniques on real field.

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to Structural Health:** Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. | 7 |
| 2 | **Structural Health Monitoring & Audit:** Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures. | 8 |
| 3 | **Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. | 8 |
| 4 | **Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring. | 8 |
| 5 | **Introduction to Repairs and Rehabilitations of Structures:** Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique. | 7 |
| 6 | **NDT (Non Destructive Testing)Techniques:** Application of NDT Techniques on real-life problems. | 7 |
| | **Total** | 45 |

**Text Books:**

1. Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, “Structural Health Monitoring”, John Wiley and Sons, 2006.
2. Douglas E Adams, “Health Monitoring of Structural Materials and Components_Methods with Applications”, John Wiley and Sons, 2000

**Reference Books:**

1. J. P. Ou, H. Li and Z. D. Duan, “Structural Health Monitoring and Intelligent Infrastructure”, Vol1, Taylor and Francis Group, London, UK, 2006.
2. Victor Giurglutiu, “Structural Health Monitoring with Wafer Active Sensors”, Academic Press Inc, 2007.

**E-Resources:**

https://archive.nptel.ac.in/courses/114/106/114106046/

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Bio-Inspired Systems and Computing (Open Elective-V) | | | | | Code: BET7601/ BET8601 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Data Science and Statistics is essential

**Course Objectives:**

1. To explain bio-inspired theorem and algorithms
2. To demonstrate role of random walk and simulated annealing
3. To discuss genetic algorithm and differential evolution with their applications
4. To elaborate use of swarm optimization and ant colony for feature selection

**Course Outcomes:** After completion of this course students will be able to,

1. Understand bio-inspired algorithms used in computing.
2. Implement optimization using genetic algorithms.
3. Explore role of swam optimization in computing algorithms
4. Apply bio inspired algorithms in image processing applications.
5. Describe bio-inspired routing protocols for VANETs
6. Understand bio-mimetically inspired robot prototype

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction:** Bio-inspired Computing, The influence of brain science on Brain-inspired computing, Development focus of bio-inspired algorithms, Paradigm of evolution of algorithms with increase of complexity of problems. Current Issues in Bio-Inspired Computing | 6 |
| 2 | **Genetic Algorithms and Differential Evolution:** Introduction to genetic algorithms, Components of genetic algorithms, Properties of genetic algorithms, Linear genetic programming, Biological vs. artificial evolution. Applications: Prediction of cancer survival | 7 |
| 3 | **Swarm Optimization And Firefly Algorithm:** Swarm intelligence - PSO algorithm, Properties of PSO, binary PSO , Types of Swarm-Intelligence-Based Algorithms. The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection. | 8 |
| 4 | **Application In Image Processing:** Bio-Inspired Computation and its Applications in Image Processing: An Overview, Improved Weighted Threshold based Histogram Equalization Algorithm for Digital Image, Contrast Enhancement Using Bat Algorithm, Mobile Object Tracking Using Cuckoo Search. | 8 |
| 5 | **Bio-Inspired Routing Protocols For Vanets:** Motivations for using bio-inspired approaches in VANET routing, Fundamental concepts and operations of bio-inspired VANET routing, Basic bio-inspired algorithms used in VANET routing literature, Swarm intelligence for VANET routing | 8 |
| 6 | **Bio-Mimetically Inspired Robot Prototype:** Definition: Bionics, Biomimetic, Bio-inspired, and Biotechnology, State of the Art in Robotics and Robotic Actuation, Biomimetically Inspired Robot Prototype, The Robot's Performance, Field of Application | 8 |
| | **Total** | 45 |

**Text Books:**


1. Yang ,Cui,XIao, Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier, First Edition, 2013
2. Xin-She Yang, Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier First edition 2016
3. Abdelhamid Mellouk, Salim Bitam, "Bio-Inspired Routing Protocols for Vehicular Ad Hoc Networks",Wiley, First edition 2014.
4. Ralf Simon King , "BiLBIQ_ A Biologically Inspired Robot with Walking and Rolling Locomotion" Volume 2, [Biosystems & Biorobotics] , Springer Berlin Heidelberg, 2012


**Reference Books:**


1. Mattias Wahde, "Biologically Inspired Optimization Methods: An Introduction", WIT Press, First edition 2008
2. Eiben, A.E.,Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
3. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
4. Acharjya, D. P._ Santhi, V - Bio-Inspired Computing for Image and Video Processing-CRC Press, 2018.
5. Xin-She Yang, "Nature Inspired Optimization Algorithm, Elsevier First Edition 2014


**Papers:**


1. Arpan Kumar Kar,Bio inspired computing – A review of algorithms and scope of applications, Expert Systems with Applications,Volume 59,2016,Pages 20-32,ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2016.04.018.

| Program: | B. Tech. (Mechanical Engineering) | | | Semester: VII/ VIII | | |
|---|---|---|---|---|---|---|
| Course: | Sensor and Automation using IoT (Open Elective-V) | | | Code: BET7602/ BET8602 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior Knowledge of:**

a. Basic Electronics Engineering

b. Programming with Arduino ……are essential

**Course Objectives:**

1. Explain fundamental methods and characteristics of measurement systems.
2. Introduction to various types of transducers with working principles
3. Make students aware of need of computer aided process automation in industrial applications.
4. Demonstrate PLC ladder programming for design of basic logic gates for various applications
5. Make students familiar with various applications of IoT.

**Course Outcomes:**

After completion of this course students will be able to,

1. Illustrate the working principle of various types of transducers and their characteristics.
2. Choose proper sensor comparing different standards, guidelines and requirements for measurements of displacement, velocity, acceleration and level.
3. Select proper sensor comparing different standards, guidelines and requirements for measurements of Temperature & Force
4. Describe the need and concept of process control and automation systems
5. Design of basic logic gates using ladder programming.
6. Explain applications of IoT for real life application in automobile and healthcare

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1. | **Introduction to Sensors and Transducers**<br>Introduction to Sensors, Description and Working principle, Types of sensors, Specifications of Sensors. Introduction to transducers, Advantages and Disadvantages of Electrical Transducers, Classification of Transducers, Static& and Dynamic characteristics, Difference between sensors and transducers | 7 |
| 2. | **Sensors for Displacement, Vibration, Acceleration and Level**<br>Classification of Displacement Sensors: Potentiometer, Strain-gauged element, Capacitive element, Differential transformers, Eddy current proximity sensors, Inductive and Capacitive Proximity switch, Optical encoders.<br>Pneumatic sensors (Bellows, Diaphragm), Hall effect sensors, Accelerometer, Gyroscope and Magnetometer (ADXL335/345), Electro-Optical Sensors, Position Encoders. | 8 |
| 3. | **Force and Temperature Sensors**<br>Basic methods and types of force measurement: elastic force, strain gauge, piezoelectric, inductive, Capacitive load cells. Methods of temperature measurement: Optical Fiber, Resistance Temperature Detectors, Thermistor, Thermocouples | 7 |
| 4. | **Computer Aided Process Control and Automation Systems**<br>Introduction of computer aided process control hardware, Industrial communication systems, Introduction of Computer based data acquisition system (DAQ), fundamentals of automation, Automation principles and | 8 |

| | | |
|---|---|---|
| | strategies, reasons for Automating, basic elements of an automated system: Power, Program and control system. | |
| **5.** | **Introduction of Programmable Logic Controllers**<br>Fundamentals of PLC, PLC selection criteria and applications of PLC. Introduction to PLC programming, Ladder diagram, Sequential flow chart, Industrial bus systems. Case Study: Basic Logic Gates implementation using Ladder programming, Temperature Measurement with interfacing to DAQ | **8** |
| **6.** | **Introduction to Internet of Things:** Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Basic Concept of IoT, Sensor Interface in IoT systems, Design Model for IoT<br>Case Study 1: IoT based Automobile Sector (Engine Management System) (Mention of Fuel Level, Ignition, Exhaust Sensors)<br>Case Study 2: IoT based Healthcare Systems (Block Diagram and Simulation) | **7** |
| | **Total** | **45** |

**Text Books:**


1. A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications, 2001
2. D. Patranbis, "Sensor and Transducers", 2nd Edition, PHI publication, 2005.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011
4. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Joe Biron& Jonathan Follett, Oreilly, "Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development", First Edition, March 2016


**Reference Books:**


1. Jacob Milman, Christos Halkias, Chetan D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education India Pvt. Ltd., Second edition, 2010
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
3. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
4. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009
5. Lucas Darnell, "The Internet of Things (A Look at Real World Use Cases and Concerns)". Kindle Edition, 2016

| Program: | B. Tech. (Mechanical Engineering) | | | Semester : VII /VIII | | |
|---|---|---|---|---|---|---|
| Course : | MOOC (Open Elective-V) | | | Code :BET7603/ BET8603 | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | Certification exam | Total |
| -- | -- | 3 | 3 | 70 | 30 | 100 |

**Guidelines for Students:**

1. Individual student can register for MOOC course of their interest in VII/VIII Sem as an option to Open Elective Course offered by institute.
2. MOOC course should be exclusive to courses undertaken by students. (Repetition of Course undertaken in any semester is not allowed.)
3. Student should submit the registration details with documentary proof to MOOC Coordinator.
4. Course selected should be Minimum of 40 -45 or Twelve-Fourteen Week contact hours.
5. Weekly assignment needs to be regularly completed as per requirement of course, which will be considered for internal assessment of course.
6. Students should submit progress report of assignment to MOOC Coordinator during the reviews.
7. At the end of the Course a detailed report on MOOC in hardcopy is mandatory.

**Evaluation Guidelines and Rubrics*:**

***As per B.Tech. R&R***

Continuous Internal Evaluation twice a semester (50 Marks):

a. Timely completion of assignment (15 marks)
b. Progress of assignment ( 10 Marks) ***Best /average of the given assignments***

1. MOOCs report Submission (20 Marks) : The student should summarize learning outcomes in report of 15-20 pages.
   Rubrics:
   a. Plagiarism of report/ paper must be below acceptable level of standard ( 5 Marks)
   b. Report must be drafted appropriately (LATEX tool but not compulsory) ( 5 Marks)
   c. Content of the report/ paper (10 Marks)
2. Final Examination Certificate (30 Marks)
   a. Appeared for Exam : 05 Marks
   b. Performance of Exam: 25 Marks

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Drone Technology (Open Elective-VI) | | | | | Code: BET7604/ BET8604 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of:**

a. Basic understanding of physics
b. sensors and actuators
c. Control systems
d. python programming …….are essential

**Course Objectives:**

1. To introduce students about the accessories of drone and its functionality.
2. To describe the students about mathematical model of quad copter drone.
3. To make the students, design and development of drone model using Simulink.
4. To discuss the implementation models of different drone based case studies.

**Course Outcomes:**

After completion of this course students will be able to,

1. Understand the basic concepts of drone technology
2. Justify specifications and requirements of customized drone design.
3. Determine different accessories of Drones as per applications.
4. Comprehend drone control system development using Simulink
5. Design Simulink model simulating the complete dynamics of quadcopter drone.
6. Evaluate the design model of existing drone base systems.

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to drones:** Unmanned Aerial Systems (UAS), Basics of drones, different body materials used for drone, different types of drones, Laws of Motion, Bernoulli's Principle, four forces of Flight, three axes of Flight. | 6 |
| 2 | **Drone accessories I:** Sensors & Motors, its types and specifications, design constraints, Test and measurement methods for drone sensors and actuators, Introduction of different types of batteries used in drone. Understand different specifications and their significance of batteries. | 7 |
| 3 | **Drone accessories II:** Propellers, Concept of propulsion, Forces working on a Flight, Principle axes and rotation of aerial systems, Role of GPS navigation and telemetry model, interfacing of GPS module to navigation drone. | 7 |
| 4 | **Drone control system development using Simulink:** Control system architecture, Quadcopter with actuator & propellers functionality block, Sensing & estimation functionality block, controller functionality block. | 8 |
| 5 | **Modelling, Simulation & Flight control design:** Dynamic quad copter system Model, flight control design, 3D visualization, testing & Tuning the model, Flight operations, Applicable software for data collection, processing, and analysis | 9 |
| 6 | **Applications of Drone Technology:** Drones in delivering mail, parcels and other cargo, Drones in agriculture, Drones in inspection of transmission lines and power distribution, Drones in disaster management (Flood, Fire etc), Case Study: Eagle Eye drone. | 8 |
| | **Total** | 45 |

**Text Books:**


1. John Baichtal ,"Building your own drones, a beginner's guide to drones, UAVS, and ROVs" Pearson Education, 1st Edition,2015
2. Muhammad Usman , "Quadcopter modeling and control with Matlab/Simulink implementation" LAB University of Applied Sciences, 1st Edition, 2020
3. K.S.Fu, R.C.Gonzalez, C.G.Lee , "Robotics control, sensing, vision and intelligence" MGH, 1st Edition, 1987


**Reference Books:**


1. R.K.Mittal , I.J.Nagrath, "Robotics and control" Tata McGraw-Hill, 1st Edition,2005
2. Ben Rupert , "Drones (The ultimate guide)", Create Space Independent Publishing Platform, 1st Edition,2017
3. Agam Kumar Tyagi, "Matlab and Simulink for engineers", Oxford University Press, 1st Edition,2012

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/VIII |
|---|---|---|---|---|---|---|
| Course: | Advanced Driver Assistance System(ADAS) (Open Elective-VI) | | | | | Code: BET7605/ BET8605 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Tutorial | Hours | Credit | FA | SA | Total |
| 3 | - | 3 | 3 | 40 | 60 | 100 |

**Prior knowledge of :**

a. e-Vehicle and Automotive Electronics is essential

**Course Objectives:**

1. To introduce Autonomous and Intelligent Vehicle Technology
2. To elaborate ADAS system architecture and features.
3. To explore role of AI in ADAS using various application in autonomous vehicle.

**Course Outcomes:**

After completion of this course students will be able to,

1. Understand the importance of ADAS in Autonomous and intelligent vehicle
2. Model Sensor technology required in prototype design used in ADAS
3. Apply AI concepts in automated analysis using vision based algorithms
4. Design automated electronics systems for driver assistance.
5. Develop models for safety system in autonomous vehicles.
6. Evaluate the test for maintenance, calibration and diagnostics of ADAS systems

**Detailed Syllabus:**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | Introduction to ADAS, General Block Diagram, Role of ADAS in Autonomous vehicle, Integration of ADAS Technology into Vehicle Electronics, Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation, Intelligent Vehicles | 6 |
| 2 | Prototype, Test, Evaluate and Validate ADAS : Generic dynamic and distributed architecture, Environment and climatic conditions , Modeling of perception sensors: Optical Sensor, RADAR, LIDAR, GNSS. | 7 |
| 3 | AI for ADAS: The construction of the intelligent vehicle's basic building blocks employing AI methods, Vision sensors, Vision algorithms, Automated Guided Autonomous Car Using Deep Learning and Computer Vision, Deep Learning for Obstacle Avoidance in Autonomous Driving | 8 |
| 4 | Electronics Systems in ADAS, Adaptive Cruise Control (ACC), Rear Cross Traffic Alert (RCTA), Vehicle Exit Alert, Front Cross Traffic Alert, Forward Collision Warning | 8 |
| 5 | Safety Systems in ADAS, Blind Spot Detection, Parking Assistance System, Intelligent Head Light Control, Occupant Protection System, Pedestrian Protection System, Evasive Steering Support. | 8 |
| 6 | Calibration of ADAS and Automated Driving Features: Calibration—An Overview Based on Ideality Equation , Common Types of Calibration in an Automated Driving System: End of Line (EoL) Calibration, Service Calibration, Online Calibration, Functional Calibration, Calibration of ADAS and Automated Driving Features , Calibration Environment for Automated Driving Vehicles, Calibration over Diagnostics Interface | 8 |
| | **Total** | 45 |

**Text Books:**


1. Abdelaziz Bensrhair (editor), Thierry Bapin (editor) - From AI to Autonomous and Connected Vehicles_ Advanced Driver-Assistance Systems (ADAS)-Wiley-ISTE (2021)
2. Plato Pathrose - ADAS and Automated Driving_ A Practical Approach to Verification and Validation-SAE International (2022)


**Reference Books:**


1. Harald Waschl, Ilya Kolmanovsky, Frank Willems - Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions-Springer, Vol. 476, 2019.
2. Lentin Joseph (editor), Amit Kumar Mondal (editor) - Autonomous Driving and Advanced Driver-Assistance Systems (ADAS)_ Applications, Development, Legal Issues, and Testing (Chapman & Hall_CRC
3. Yan Li, Hualiang Shi - Advanced Driver Assistance Systems and Autonomous Vehicles_ From Fundamentals to Applications-Springer (2022) /


**Online Course:**

1. https://www.udemy.com/course/advanced-driver-assistance-systems

# Course Syllabus

## Final Year B Tech – Scheme A/B/C

## Semester-VII/VIII

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Project (Scheme B/A) | | | | | Code: BME7701/ BME8701 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | TW | OR | Total |
| - | 28 | 28 | 14 | 200 | 150 | 350 |

**Prior knowledge of:** All the courses

**Course Objectives:**

1. To provide an opportunity of designing and building complete systems or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them get confidence by planning and carrying out the project's work plan and to complete the same through observations, discussions successfully, and the decision-making process.
5. To get visibility in the industry to Project and Project Group

**Course Outcomes:**

After learning the course, the students should be able to

1. **Demonstrate** sound academic fundamentals to formulate and analyze complex Mechanical engineering problems.
2. **Provide creative/ innovative solutions** for complex engineering problems.
3. **Design Mechanical systems/products/processes** for providing solutions to environmental issues/ needs of society/Industry/ safety issues.
4. **Apply** modern modeling and simulation techniques/ computing tools.
5. **Work effectively as a team member / Leader** in order to manage the project work and finance.
6. **Write a report** on the research work and present it effectively.

**Detailed Syllabus:**

The evaluation of the project work will be done considering the performance of students in **Reviews 1,2, 3, & the final examination.**

| Review | Description |
|---|---|
| **1.** | **Review 1** will be planned at the beginning of semester VIII (Within 1 month of semester commencement). Review 1 will be purely a synopsis presentation, which the DPAC will take. The assessment of this review will be considered for Internal evaluation. Students shall prepare the presentation on selected project ideas according to their area of interest. The brief presentation with the precise aim and objectives of the project shall be presented in front of the DPAC after approval from the respective project guide.<br>The following points can be considered for the preparation of the review 1 presentation synopsis report:<br>• Title Page: (Title of Project, Names of Students, Name of Guide)<br>• Introduction<br>• Need of the project<br>• Objectives<br>• Scope<br>• Problem Definition<br>• Proposed Initial Design<br>• Literature referred |

| | |
|---|---|
| | • Methodology Planned for achieving the Aim and objectives of the project<br>• Expenditure<br>• Time Activity Chart<br>• References |
| **2.** | **Review 2** will be planned after one month of review 1. The aim of review 2 is to look into the progress of the student after review 1. The assessment of this review will be considered for Term work evaluation. The DPAC shall check whether the student has answered and compiled the queries raised in review 1. The objective of review 2 is to identify the progress of the student group in line with their methodology planned. The following points can be considered for the Review 2 presentation:<br>o Study of data<br>o Modeling/System Design<br>o Design calculations<br>o Numerical Simulation /Mathematical model<br>o Finalization of design |
| **3.** | **Review 3:** This will be planned after one month of review 2. This is the final departmental review of the project work. The assessment of this review will be considered for Term work evaluation. The DPAC shall check whether the student has answered and compiled the queries raised in review 2. The objective of review 3 is to identify the progress of the student group in line with their methodology planned. This review will ensure the completeness of the project work. In this review, the student shall complete the project report and be able to demonstrate the work. The following points can be considered for the review 3:<br>• Manufacturing/ procurement of components<br>• Fabrication / Manufacturing of set up<br>• Experimentation/ Testing<br>• Data analysis<br>• Design Validation<br>• Implementation<br>• Report writing<br>• Plagiarism report/ Similarity report **(max 30%)** |
| **Final Examination** | **Final Examination:** Final Examination will be scheduled after review 3 as per the schedule provided by the examination section. This examination will be carried out under the supervision of the Project guide and appointed External examiner. For the final examination, the student shall complete the project report in all aspects, including formatting. |

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VII/ VIII |
|---|---|---|---|---|---|---|
| Course: | Internship | | | | | Code: BME7801/ BME8801 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Tutorial | Credit | TW | OR | Total |
| - | 6 | - | 3 | 100 | -- | 100 |

**Preamble:**

Internships are educational and career development opportunities, providing practical experience in a field. Employers are looking for employees who are properly skilled and have awareness of the industry environment, practices, and culture. The internship is structured, short-term, supervised training often focused on particular tasks or projects with defined time scales.

The core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and understanding the social, economic, and administrative considerations that influence the working environment of industrial organizations.

**Course Objectives:**

1. To expose students to the industry environment and enhance the technical skills while working in the private / public enterprises, government agencies, research labs, or any other organized technical club.
2. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
3. To develop higher order thinking skills to work with people of diverse backgrounds and cultures and to work effectively within cross-disciplined environments.

**Course Outcomes:**

On the completion of the course, students will be able to-

1. Demonstrate and apply the academic theory and integrate the fundamental concepts in practice through internship and record the industrial or project activities.
2. Apply appropriate methods and tools to understand and solve given problem and implement improved writing skills to prepare the report.
3. Deliver effective oral presentation by demonstrating effective communication and professional skills and explore carrier opportunities.

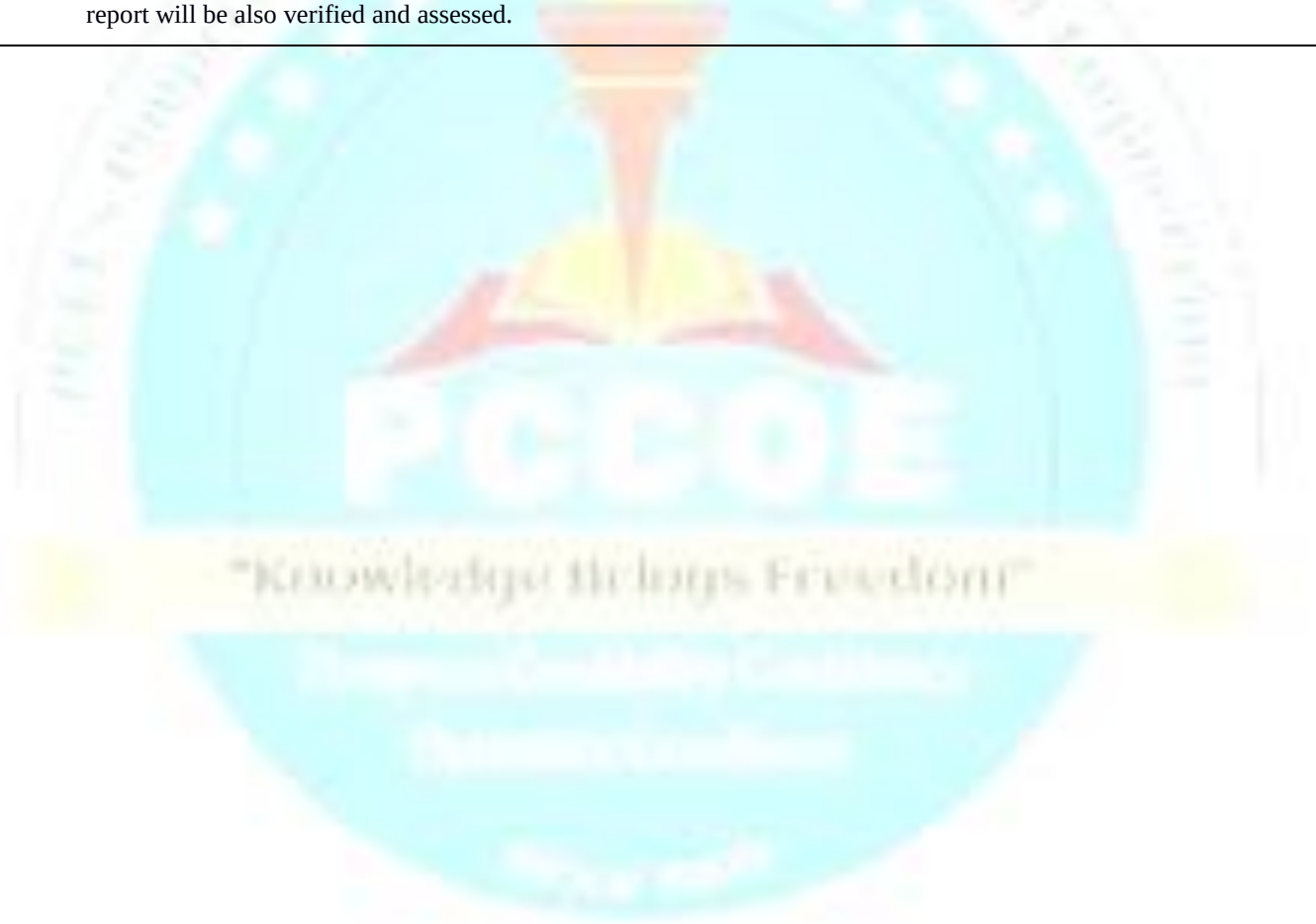
**Internship Guidelines:**

1. It is mandatory for all students to undergo an internship between $6^{th}$ and $7^{th}$ semester summer vacations for the duration of minimum 4 weeks. Internship done during this period will be considered for assessment of TW.
2. The possible opportunities of internships can be availed from
    a. Industries
    b. Research labs or organization
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. Students who are working in various collegiate clubs / teams (like teams associated with SAE BAJA, SAE SUPRA, SAE TIFAN, SAE AERO, ESVC, ROBOCON, clubs etc.) are considered as the internship opportunities. However, such students have to submit the offer letter from the relevant team(s) to the Internship Coordinator and HOD Office.
4. Students can seek help from
    a. the Training and Placement cell along with departmental coordinators assistance
    b. the department / institute faculty members
    c. various personal contacts
    d. students can individually connect with the industries / organizations
5. Once industry / research organization / collegiate club is identified, student is required to get request letter from the Mechanical Engineering Department duly signed by Head of the Department to seek an opportunity for the internship.

The letter should be addressed to the HR manager or relevant authority and details should be available with the students.

6. The students are requested to submit the confirmation letter from the industry or research organization or collegiate club to the Internship Coordinator and HOD Office
7. Students on joining the internship will submit the joining report / joining letter / or copy of the confirmation email to Internship Coordinator and HOD Office.
8. A faculty member will be associated as a mentor for group of students. He/she will be responsible for monitoring, evaluation and assessment of student internship activities. Faculty is also requested to visit the internship place and submit the formal feedback to the Internship Coordinator.

9. Faculty members are advised to visit the place of internship once / twice during internship period and monitor the progress.
10. The students should submit the progress report fortnightly to the guide and final internship report to the internship coordinator and department office.
11. After completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students in department office / internship coordinator.
12. Student should receive the Internship Certificate from industry and submit to the internship coordinator and department office.
13. Students shall give a presentation on the internship work carried as a part of Term work. The internship diary and report will be also verified and assessed.



| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VIII |
|---|---|---|---|---|---|---|
| Course: | Project Stage II | | | | | Code: BME8702 |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Hours | Credit | TW | OR | Total |
| - | 16 | 16 | 8 | 100 | 100 | 200 |

**Prior knowledge of:** All the courses

**Course Objectives:**

1. To provide an opportunity of designing and building complete systems or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them get confidence by planning and carrying out the project's work plan and to complete the same through observations, discussions successfully, and the decision-making process.
5. To get visibility in the industry to Project and Project Group

**Course Outcomes:** After learning the course, the students should be able to

1. **Demonstrate** sound academic fundamentals to formulate and analyze complex Mechanical engineering problems.
2. **Provide creative/ innovative solutions** for complex engineering problems.
3. **Design Mechanical systems/products/processes** for providing solutions to environmental issues/ needs of society/Industry/ safety issues.
4. **Apply** modern modeling and simulation techniques/ computing tools.
5. **Work effectively as a team member / Leader** in order to manage the project work and finance.
6. **Write a report** on the research work and present it effectively.

**Detailed Syllabus:**

The evaluation of project stage II will be done considering the performance of students in Reviews 1, 2, and the final examination. For details, kindly refer to the project guidelines.

| Review | Description |
|---|---|
| 1. | **Project Stage 2 Review 1:** Project Stage 2 will start after the student successfully completes all the requirements of Project Stage 1. The project stage 2 review 1 will be planned at the beginning of semester VIII (Within a month of semester commencement). The assessment of this review will be considered for Internal evaluation. |
| 2. | **Project Stage 2 Review 2:** This will be planned after 1.5 months of review 3. This is the final departmental review of the project work. The assessment of this review will be considered for Term work evaluation. The DPAC shall check whether the student has answered and compiled the queries raised in review 1. The objective of review 2 is to identify the progress of the student group in line with their methodology planned. This review will ensure the completeness of the project work. In this review, the student shall complete the project report and be able to demonstrate the work. The following points can be considered for the review 2:<br>• Manufacturing/ procurement of components<br>• Fabrication / Manufacturing of set up<br>• Experimentation/ Testing<br>• Data analysis<br>• Design Validation<br>• Implementation<br>• Report writing<br>• Plagiarism report/ Similarity report **(max 30%)** |
| **Final Examination** | **Project Stage 2 Final Examination:** Final Examination will be scheduled after review 2 as per the schedule provided by the examination section. This examination will be carried out under the supervision of the Project guide and appointed External examiner. For the final examination, the student shall complete the project report in all aspects, including formatting. Each Student shall prepare the report duly signed by the project guide, head of the department, director, and external examiner. Along with this, students are required to prepare two extra copies of the project report duly signed by the above-mentioned authorities. Students shall submit all the data related to project work in soft copy to their guides, including project reports, Presentations, CAD and CAE files, etc. |

| Program: | B. Tech. (Mechanical Engineering) | | | | | Semester: VIII | |
|---|---|---|---|---|---|---|---|
| Course: | Internship (for Scheme C) | | | | | Code: BME8801 | |
| Teaching Scheme | | | | Evaluation Scheme | | | |
| Lecture | Practical | Tutorial | Credit | TW | PR | OR | Total |
| - | - | - | 3 | 100 | - | - | 100 |

**Preamble:**

Internships are educational and career development opportunities, providing practical experience in a field. Employers are looking for employees who are properly skilled and have awareness of the industry environment, practices, and culture. The internship is structured, short-term, supervised training often focused on particular tasks or projects with defined time scales. The core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and understanding the social, economic, and administrative considerations that influence the working environment of industrial organizations.

**Course Objectives:**

1. To expose students to the industry environment and enhance the technical skills while working in the private / public enterprises, government agencies, research labs, or any other organized technical club.
2. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
3. To develop higher order thinking skills to work with people of diverse backgrounds and cultures and to work effectively within cross-disciplined environments.

**Course Outcomes:**

On the completion of the course, students will be able to-

1. Demonstrate and apply the academic theory and integrate the fundamental concepts in practice through internship and record the industrial or project activities.
2. Apply appropriate methods and tools to understand and solve given problem and implement improved writing skills to prepare the report.
3. Deliver effective oral presentation by demonstrating effective communication, and professional skills and explore carrier opportunities.

**Internship Guidelines:**

1. It is mandatory for all students to undergo an internship between 6$^{th}$ and 7$^{th}$ semester summer vacations for the duration of minimum 4 weeks. Internship done during this period will be considered for assessment of TW.
2. The possible opportunities of internships can be availed from
    a. Industries
    b. Research labs or organization
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. Students who are working in various collegiate clubs / teams (like teams associated with SAE BAJA, SAE SUPRA, SAE TIFAN, SAE AERO, ESVC, ROBOCON, clubs etc.) are considered as the internship opportunities. However, such students have to submit the offer letter from the relevant team(s) to the Internship Coordinator and HOD Office.
4. Students can seek help from
    a. the Training and Placement cell along with departmental coordinators assistance
    b. the department / institute faculty members
    c. various personal contacts
    d. students can individually connect with the industries / organizations
5. Once industry / research organization / collegiate club is identified, student is required to get request letter from the Mechanical Engineering Department duly signed by Head of the Department to seek an opportunity for the internship. The letter should be addressed to the HR manager or relevant authority and details should be available with the students.
6. The students are requested to submit the confirmation letter from the industry or research organization or collegiate club to the Internship Coordinator and HOD Office
7. Students on joining the internship will submit the joining report / joining letter / or copy of the confirmation email to Internship Coordinator and HOD Office

# DEPARTMENT OF MECHANICAL ENGINEERING

## VISION

**To be the department of sustainable academic excellence, fostering innovation, skill development, and work ethics leading to globally competent mechanical engineers.**

जागतिक स्तरावर सक्षम यांत्रिक अभियंत्यांना मार्गदर्शन करणारा नावीन्य, कौशल्य विकास आणि कामाच्या नैतिकतेला चालना देणारा शाश्वत शैक्षणिक उत्कृष्टतेचा विभाग बनणे.

## MISSION

1. **Nurture cohesive learning environment and develop matching ecosystem.**

   एकसंध शिक्षण वातावरण जोपासणे आणि जुळणारी परिसंस्था विकसित करणे.

2. **Cultivate excellent work ethics and right attitude among students by imparting essential skills and knowledge.**

   आवश्यक कौशल्ये आणि ज्ञान देऊन विद्यार्थ्यांमध्ये उत्कृष्ट कार्य नैतिकता आणि योग्य दृष्टिकोन विकसित करणे.

3. **Instill a sense of creativity, social responsibility and environmental awareness among students.**

   विद्यार्थ्यांमध्ये सर्जनशीलता, सामाजिक जबाबदारी, आणि पर्यावरण विषयक जागरुकता निर्माण करणे.

# DEPARTMENT OF MECHANICAL ENGINEERING

## Program Educational Objectives

1. To cultivate knowledge and skills in formulating, analyzing, and solving interdisciplinary engineering problems among the mechanical engineering graduates.
2. To inculcate right attitude and awareness about codes of professional practice, social commitment, and life-long learning among the mechanical engineering graduates.
3. To enhance professional competence for catering to the needs and expectations of society as a profound Mechanical Engineer.

## Program Specific Outcomes

1. Conceptualize, design, model, simulate, and analyze mechanical components, systems and processes in complex interdisciplinary applications.
2. Develop sustainable solutions to real-life mechanical engineering problems in products and process industries.
3. To practice professional codes and conducts, safety norms, industrial engineering and management principles while working in the industry or as an entrepreneur.