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**SYLLABUS**

**B. TECH.**

AUTOMOBILE Engineering 4 Year Program

**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**Teaching and Examination Scheme common for B.Tech. (Automobile Engineering 4 Year Program) Edition 2015
Year: II Semester: III**

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| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Humanity and Social Studies | 3 | 3 |  |  |  |  |  |
| 2 |  | Employability Skill 2 | 1 | 1 |  |  |  |  |  |
| 3 |  | Advance Maths | 4 | 3 | 1 | - |  |  |  |
| 4 |  | Discipline and Co-Curricular Activities | 2 |  |  |  |  |  |  |
|  |  | **Program Core** |  |  |  |  |  |  |  |
| 5 | ME 201 | Fundamentals of Thermodynamics | 4 | 3 | 1 | - | 3 | 30 | 70 |
| 6 | ME 203 | Mechanics of Solid | 4 | 3 | 1 | - | 3 | 30 | 70 |
| 7 | ME 251 | Thermal Engg. Lab. – I | 2 | - | -  | 3 | 3 | 60 | 40 |
| 8 | ME 253 | Strength of Material Lab. | 2 | - |  - | 3 | 3 | 60 | 40 |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 9 | ME 215 | Automotive Petrol engine  | 3 | 3 | - | - | 3 | 30 | 70 |
| 10 | AE 201 | Production Process-I | 3 | 3 | 0 | - | 3 | 30 | 70 |
| 11 | ME 255 | Production Process Lab | 1 | -- | -  | 2 | 3 | 60 | 40 |
| 12 | ME 261 | Engine testing lab | 1 | - |  - | 2 | 3 | 60 | 40 |
|  |  | **University Elective** | 3 |  |  |  |  |  |  |
| 13 | EC 221 | Electronics Devices and Circuits | 3 | 3 | - | - |  |  |  |
| 14 | EC 252 | Electronics Lab | 1 | - | - | 2 |  |  |  |
| 15 | EC 213 | Medical Electronics | 3 | 3 | - | - |  |  |  |
|   |   |  |  |  |  |  |  |  |  |
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**Year: II Semester: IV**

 ***Note:- Industrial training for 30 days after 4th Semester Exams is compulsory.***

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| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Employability Skill 3 | 1 | 1 |  |  |  |  |  |
| 2 |  | Discipline and Co-Curricular Activities | 2 |  |  |  |  |  |  |
|  |  | **Program Core** |  |  |  |  |  |  |  |
| 3 |  ME 213 | Kinematics of machine -I | 3 | 3 | - |   | 3 | 30 | 70 |
| 4 | AE 208 | Fluid Engineering | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 5 |  AE-212 | Automotive Diesel Engine | 3 | 3 | - |   | 3 | 30 | 70 |
| 6 |  AE-214 | Motor Vehicle Technology | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 7 | AE 355 | Kinematics of machine lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 8 | AE 256 | Fluid Engineering Lab. | 2 | 0 |   | 3 | 3 | 60 | 40 |
| 9 |  AE -260 | Motor Vehicle Technology Lab | 2 | 0 |   | 3 | 3 | 60 | 40 |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 10 | ME 212 | Instrumentation & Control | - | - | - | - | - | - | - |
| 11 |  EC-224 | Electronics engineering | - | - | - | - | - | - | - |
| 12 | EE 204 | Electro Mechanical Energy Conversion ­­-II | - | - | - | - | - | - | - |
| 13 | HS202 | Cognitive Skill | - | - | - | - | - | - | - |
|  |  | **University / Open Elective** |  |  |  |  |  |  |  |
| 14 | EC 210 | Telecomm Engineering Fundamentals | 3 | 3 | - | - |  |  |  |
| 15 | CP 209 | Business Eonomics | 3 | 3 | - | - |  |  |  |
| 16 | \*\*\*\* | Fundamental of Optical Communication  | 3 | 3 | - | - |  |  |  |
| 17 | \*\*\*\* | Communication Lab | 1 | - | - | 2 |  |  |  |
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**Year: III Semester: V**

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| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Employability Skill 4 | 1 | 1 |  |  |  |  |  |
| 2 |  | Practical Training Seminar I | 1 | - | - | 2 |  |  |  |
| 3 |  | Discipline and Co-Curricular Activities | 2 |  |  |  |  |  |  |
|  |  | **Program Core** |  |  |  |  |  |  |  |
| 4 | AE 301 | Heat transfer in IC engine | 3 | 3 | - |   | 3 | 30 | 70 |
| 5 | AE 303 | Automotive Electricals andElectronics | 3 | 3 | - |   | 3 | 30 | 70 |
| 6 | AE 306 | Design of machine element II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 7 | AE 307 | Automotive Transmission | 3 | 3 | - |   | 3 | 30 | 70 |
| 8 | AE 351 | Thermal engg. Lab-II | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 9 | AE 353 | Automotive electricals andelectronics lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 10 | ME254 |  Machine Element Design Lab  | 2 |   |   | 3 | 3 | 60 | 40 |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |  |
| 13 | AE 311 | Kinematics of machine -II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 14 | AE 357 | Auto shop practice lab | 1 |  |  | 2 | 3 | 60 | 40 |
| 15 |  |  |  |  |  |  |  |  |  |
|  |  | **University / Open Elective** |  |  |  |  |  |  |  |
| 15 | \*\*\*\*\* | Project Planning and construction management | 3 | 3 | - | - |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  16 | CP 210 | Management Information System | 3 | 3 | - | - |  |  |  |
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**Year: III Semester: VI**

|  |  |  |  |  |  |  |
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| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Employability Skills 5 | 1 | 1 |  |  |  |  |  |
| 2 |  | Discipline and Co-Curricular Activities | 2 |  |  |  |  |  |  |
|  |   | **Program Core** |  |  |  |  |  |  |  |
| 3 | AE 302 | Auto chassis and auto system design | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 4 | AE 304 | Automatic control engineering | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 5 | ME 311 | Mechanical Vibration & Noise Viberation | 4 | 3 | 1 |  | 3 | 30 | 70 |
| 6 | AE 308 | Vehicle Dynamics  | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 7 | AE 354 | Vehicle dynamics lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 8 | ME 357 | Mechanical Vibration & Noise Viberation Lab | 1 |   |   | 2 | 3 | 60 | 40 |
| 9 |  | Project Stage­I | 2 |   |   | 3 | 3 | 60 | 40 |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 10 | AE 310 | Auto Emission and pollution control | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 11 | AE 352 | Auto transmission lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 12 |  |  |  |  |  |  |  |  |  |
| 13 |  |  |  |  |  |  |  |  |  |
|  |  | **University / Open Elective** |  |  |  |  |  |  |  |
| 14 | CP 314 | Simulation Modelling | 3 | 3 | - | - |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| 15 | CP 316 | Bioinformatics | 3 | 3 | - | - |  |  |  |
|  16 |   | Network Simulation Lab | 1 | - | - | 2 |  |  |  |

**Year: IV Semester: VII**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Employability Skills 6 | 1 | 1 |  |  |  |  |  |
| 2 |  | Practical Training Seminar II | 1 | - | - | 2 |  |  |  |
| 3 |  | Discipline and Co-Curricular Activities | 2 |  |  |  |  |  |  |
|  |   | **Program Core** |  |  |  |  |  |  |  |
| 4 | AE 401 | CAD | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 5 | AE 403 | Automatic heating, ventilation and air conditioning | 4 | 3 | 1 |   | 3 | 30 | 70 |
| 6 | AE359 | Safety and comfort of Vehicle  | 3 | 3 | 0 |  | 3 | 30 | 70 |
| 7 | AE 407 | Microprocessor application inautomobile | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 8 | AE 356 | Automotive system and pollution lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| 9 | AE 453 | CAD lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| 10 | PT 401 | Training Seminar | 2 | 0 |   | 3 | 3 | 60 | 40 |
| 11 | PE 401 | Project stage-II | 2 | 0 |   | 3 | 3  | 60 | 40 |
|  |  | **Program Elective** |  |  |  |  |  |  |  |
| 12 |  AE 409  | Vehicle Aerodynamics and vehicle body Engg. | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 13 | AE 455 | Body engineering lab | 1 | 0 |  | 2 | 3 | 60 | 40 |
| 14 | ME 411 | Finite Element Analysis | 2 |  | - | - | - | - | - |
| 15 | BM 449 | Entrepreneurship Development | 2 | - | - | - | - | - | - |
|  |  | **University / Open Elective** |  |  |  |  |  |  |  |
| 16 | CE315 | Solid Waste Management | 2 | 2 | - | - | 3 | 30 | 70 |
| 17 | CE217 | E-Commerce | 3 | 3 | - | - | 3 | 30 | 70 |
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**Year: IV Semester: VIII**

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| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T** | **P** | **CIE** | **ESE**  |
|   |   | **University Core** |  |  |  |  |  |  |  |
| 1 |  | Intellectual Property Right  | 2 | 2 | - | - |  |  |  |
| 2 |  | B.Tech seminar | 1 | - | - | 2 |  |  |  |
|  |   | **Program Core** |  |  |  |  |  |  |  |
| 3 | ME 410 | Computational fluid Dynamics and Heat Transfer |  3 | 3 |  0 | 0 | 3 | 30 | -70 |
| 4 | AE 404 | Industrial robotics | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 5 | ME 408 | Product Design and Development | 3 | 3 | 0 |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |
| 8 | AE 454 | Auto Reconditioning lab | 1 | 0 |   | 2 |  3 | 60 | 40 |
| 9 | SM 402 | Seminar | 3 | 0 |   | 6 |  3 | 60 | 40 |
|  |  | **Program Elective** | 3 |  |  |  |  |  |  |
| 10 | AE 406 | Automotive Maintenance Management | 3 | 3 | 0 |   | 3 | 30 | 70 |
| 11 | AE 452 | Auto Maintenance lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| 12 | AE 456 | Computational fljid dynamics lab | 2 | 0 |  | 3 | 3 | 60 | 40 |
| 13 |  |  |  |  |  |  |  |  |  |
| 14 |  |  |  |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |  |  |  |
|  |  | **University / Open Elective** | 1 | - | - | 2 |  |  |  |
| 17 | \*\*\*\*\* | SAP lab(ERP/MM) | 1 | - | - | 2 |  |  |  |
| 19 | \*\*\*\*\* | Actuarial Science |  |  |  |  |  |  |  |
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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**LIST OF COURSES OFFERED**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | **Exam Hrs.** | **Weightage (in%)** |
| **L** | **T/S** | **P** | **CE** | **ESE**  |
| **AUTOMOBILE ENGINEERING** |
| AE 201 | Manufacturing Process  | 3 | 3 | 0 | - | 3 | 30 | 70 |
| AE 202 | Design of Machine Elements –I | 3 | 3 | - |   | 3 | 30 | 70 |
| \* AE 204 | Machining and Machine Tool | 3 | 3 | - |   | 3 | 30 | 70 |
| AE 206 | Automotive System | 3 | 3 | - |   | 3 | 30 | 70 |
| \* AE 208 | Fluid Engineering | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 210 | Computer Graphics and Design | 3 | 3 | - |   | 3 | 30 | 70 |
| \*AE-212 | Automotive Diesel Engine | 3 | 3 | - |   | 3 | 30 | 70 |
|  ME 213 | KOM-I |  3 | 3 | - |  | - | - | - |
| \* AE-214 | Motor Vehicle Technology | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 215 | Automotive Petrol engine  | 3 | 3 | - | - | 3 | 30 | 70 |
| \*AE-216 | Machine Drawing & Machine Design | 3 | 3 | - |   | 3 | 30 | 70 |
| AE 252 | Elements of Machine Design - Lab I  | 1 | 0 |   | 2 | 3 | 60 | 40 |
| \* AE 254 | Machining and Machine Tool Lab  | 2 | 0 |   | 3 | 3 | 60 | 40 |
| \* AE 256 | Fluid Engineering Lab. | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 258 | Software and Computer Graphics Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| \* AE-260  | Motor Vehicle Technology Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
|  |  |  |  |  |  |  |  |  |
| AE 301 | Heat transfer in IC engine | 3 | 3 | - |   | 3 | 30 | 70 |
| AE 302 | Auto chassis and auto system design | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 303 | Automotive Electricals and Electronics | 3 | 3 | - |   | 3 | 30 | 70 |
| AE 304 | Automatic control engineering | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 305 | Advanced IC engine-I | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 306 | Design of machine element II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 307 | Automotive Transmission | 3 | 3 | - |   | 3 | 30 | 70 |
| AE 308 | Vehicle Dynamics  | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 309 | Theory of Machines | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 310 | Auto Emission and pollution control | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 311 | Kinematics of machine -II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 351 | Thermal engg. Lab-II | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 352 | Auto transmission lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 353 | Automotive electrical and electronics lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 354 | Vehicle dynamics lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 355 | Dynamics of machine lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 356 | Automotive system and pollution lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE 358 | Machine design lab II | 1 | 0 |   | 2 | 3 | 60 | 40 |
| AE359 | Safety and comfort of vehicle | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| AE 401 | CAD | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 402 | Alternative Fuels and Engine Tribology | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 403 | Automatic heating, ventilation and air conditioning | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 404 | Industrial robotics | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 405 | Advanced IC Engine II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| AE 406 | Automotive Maintenance Management | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 407 | Microprocessor application in automobile | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 409  | Vehicle Aerodynamics and vehicle body Engg. | 3 | 3 | 0 |   | 3 | 30 | 70 |
| AE 451 | I C engines lab-II | 1 | 0 |   | 2 | 3  | 60 | 40 |
| AE 452 | Auto Maintenance lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| AE 453 | CAD lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| AE 454 | Auto Reconditioning lab | 1 | 0 |   | 2 |  3 | 60 | 40 |
| AE 455 | Body engineering lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
|  AE 456 | Comutational fluid Dynamics | 2 | 0 |  | 3 | 3 | 60 | 40 |
| **MECHANICAL ENGINEERING** |
| ME 101/ME 102 | Engg. Mechanics | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| ME 151/ME 152 | Auto CAD Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| ME 153/ME 154 | Workshop Practice | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| ME 201 | Fundamentals of Thermodynamics | 4 | 3 | 1 | - | 3 | 30 | 70 |
| ME 202 | Machine Design | 3 | 3 | - |   | 3 | 30 | 70 |
| ME 203 | Mechanics of Solid | 4 | 3 | 1 | - | 3 | 30 | 70 |
| ME 204 | Industrial Engg. – I | 3 | 3 | - |   | 3 | 30 | 70 |
| ME 205 | Material Science | 3 | 3 | - | - | 3 | 30 | 70 |
| ME 206 | Production Process – I | 3 | 3 | - |   | 3 | 30 | 70 |
| ME 207 | Elements of Machine Design | 4 | 3 | 1 | - | 3 | 30 | 70 |
| ME 208 | Fluid Mechanics | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 209 | Object Oriented Programming | - | - | - | - | - | - | - |
| ME 210 | Internal Combustion Engines | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 212 | Instrumentation & Control | - | - | - | - | - | - | - |
| ME 251 | Thermal Engg. Lab. – I | 1 | - | -  | 2 | 3 | 60 | 40 |
| ME 252 | Machine Design Lab. | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 253 | Strength of Material Lab. | 1 | - |  - | 2 | 3 | 60 | 40 |
| ME 253 | Strength of Material Lab. | 1 | - |  - | 2 | 3 | 60 | 40 |
| ME 254 | Production Process – I Lab  | 2 | 0 |   | 3 | 3 | 60 | 40 |
| ME 255 | Material Science Lab. | 1 | -- | -  | 2 | 3 | 60 | 40 |
| ME 256 | Fluid Mechanics Lab. | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 257 | Machine Drawing Lab | 2 | - |  - | 3 | 3 | 60 | 40 |
| ME 258 | Internal Combustion Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 260 | Production Process I Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 261 | Machine Drawing Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 301 | Production Process – II | 3 | 3 | - |   | 3 | 30 | 70 |
| ME 302 | Dynamics of Machine – II | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 303 | Fluid Machines | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| ME 304 | Heat & Mass Transfer | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 305 | Dynamics of Machine – I | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 306 | Steam Turbine & Steam Power Plant | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 307 | Fundamental of Aerodynamics | 3 | 3 | - |   | 3 | 30 | 70 |
| ME 308 | Automobile Engg. | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 309 | Mechanical Vibration & Noise Engg. | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 310 | Industrial Engg. – II | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 311 | Mechatronics | - | - | - | - | - | - | - |
| ME 312 | Computational fluid Dynamics and Heat Transfer | - | - | - | - | - | - | - |
| ME 313 | Facility Planning & Material Handling |  - | - | - | - | - | - | - |
| ME 314 | Numerical Methods and Applied Statistics | -  | - | - | - | - | - | - |
| ME 318 | Automobile and IC Engine | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| ME 351 | Production Process Lab – II | 2 | 0 |   | 3 | 3 | 60 | 40 |
| ME 352 | Dynamics of Machine – II Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 353 | Fluid Machines Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 354 | Heat & Mass Transfer Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 355 | Dynamics of Machine Lab – I | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 356 | Automobile Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 357 | Mechanical Vibration Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 358 | Industrial Engg. Lab. | 1 | 0 |   | 2 | 3 | 60 | 40 |
| ME 362 | Automobile and IC engine | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 401 | Computer Aided Design  | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| ME 402 | Computer Aided Manufacturing | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 403 | Refrigeration and Air-Conditioning | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 404 | Power Plant Engg. | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 405 | Operation Research | 4 | 3 | 1 |   | 3 | 30 | 70 |
| ME 406 | Production Process – III | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 407 | Reliability and Maintenance Engg. | - | - | - | - | - | - | - |
| ME 408 | Product Design and Development | - | - | - | - | - | - | - |
| ME 408 | Product Design and Development | - | - | - | - | - | - | - |
|  ME 409  | Gas Turbine & Jet Propulsion | 3 | 3 | 0 |   | 3 | 30 | 70 |
| ME 410 | Computational fluid Dynamics and Heat Transfer |  - | - | - | - | - | - | - |
| ME 411 | Finite Element Analysis | - | - | - | - | - | - | - |
| ME 412 | Operation Management |  - | - | - | - | - | - | - |
| ME 415 | Fundamental Of Robotics | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| ME 451 | CAD Lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| ME 452 | CAM Lab | 1 | 0 |   | 2 |   | 60 | 40 |
| ME 453 | RAC Lab | 1 | 0 |   | 2 | 3  | 60 | 40 |
| ME 454 | Production Process – III Lab | 2 | 0 |   | 3 |   | 60 | 40 |
| ME 458 | CAD/CAM Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 460 | Product Design & Development Lab.  | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| ME 518 | Industrial Automation | 3 | 3 | 0 | 0 | 0 | 30 | 70 |
| ME 520 | Supply Chain Management  | 3 | 3 | 0 | 0 | 0 | 30 | 70 |
| **COMPUTER SCIENCE** |
| CP 101 | Computer Systems &Prog. | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| CP 102 | C++ | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| CP 151/CP 152 | Computer Programming Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| CP 154 | OOPS Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| CP 216 | Object Oriented Programming ( core java ) | - | - | - | - | - | - | - |
| CP 260 | Advanced Computer Programming Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| CP 301 | Data Base Management System | - | - | - | - | - | - | - |
| CP 307 | Computer Graphics | - | - | - | - | - | - | - |
| CP 415 | Neural Networks | - | - | - | - | - | - | - |
| CP 605 | Information Security System | - | - | - | - | - | - | - |
| **INFORMATION TECHNOLOGY** |
| IT 101/IT 102 | Information Technology | 2 | 2 | 0 | 0 | 3 | 30 | 70 |
| **ELECTRONICS & COMMUNICATION** |
| EC 201 | EDC | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 204 | Digital Hardware Design | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 208 | Telecommunication Engg. | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| \* EC-224 | Electronics engineering | - | - | - | - | - | - | - |
| EC 253 | EDC Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EC 254 | Digital Hardware Design lab | 1 | - | - | 2 | 3 | 60 | 40 |
| \*EC-256 | Electronics Engineering Lab | 1 | 0 |   | 2 | 3 | 60 | 40 |
| EC 302 A | Microprocessor | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 305 | Linear Integrated Circuit | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 311 | Signal and Networking | - | - | - | - | - | - | - |
| EC 317 | Principle of Communication Systems | - | - | - | - | - | - | - |
| EC 318 | Communication System | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 353 | Electronic Engineering Design Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EC 355 | Microprocessor Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EC 401 | Antenna & Wave Propagation | - | - | - | - | - | - | - |
| EC 403 | Wireless Communication | - | - | - | - | - | - | - |
| EC 405 | Microcontrollers & Embedded System  | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 407 | VLSI Design | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EC 410 | Image Processing & Pattern Recognition | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| EC 453 | Microcontroller Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EC 456 |  Signal Processing Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EC 601 | Embedded System Design | - | - | - | - | - | - | - |
| EC 615 | Micro-Electro-Mechanical-Systems (MEMS) |   |   |   |   |   |   |   |
| EC 619 | Wireless Sensor Networks | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| **ELECTRICAL ENGG.** |
| EE 101/EE 102 | Electrical & Electronics Engineering  | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| EE 151/EE 152 | Electrical & Electronics Engg. Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| EE 204 | Electro Mechanical Energy Conversion ­­–II | - | - | - | - | - | - | - |
| EE 205 | Electro Mechanical Energy Conversion ­­–I | - | - | - | - | - | - | - |
| EE 253 |  Electro Mechanical Energy Conversion I Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
| EE 402 |  Electrical Drives  | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| **PHYSICS** |
| PY 101/PY 102 | Engg. Physics  | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| PY 151/PY 152 | Engg. Physics Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| **CHEMISTRY** |
| CY 101/CY 102 | Engg. Chemistry | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| CY 151/CY 152 | Engg. Chem. Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| **ENGLISH** |
| EN 101 | Engineering English | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| EN 102 | Communication Techniques | 3 | 3 | 0 | 0 | 3 | 30 | 70 |
| EN 151 | English Communication Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| EN 152 | Language Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| **MATHS** |
| MA 101 | Engineering Mathematics- I | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| MA 102 | Engineering Mathematics- II | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| MA 201 | Integral Transforms & Complex Analysis | 4 | 3 | 1 | 0 | 3 | 30 | 70 |
| MA 205 | Advance Engg. Mathematics-III | 4 | 3 | 1 | - | 3 | 30 | 70 |
| **ENVIRONMENTAL STUDIES** |
| ES 101/ ES102 | Environmental Studies | 2 | 2 | 0 | 0 | 3 | 30 | 70 |
| **MANAGEMENT** |
| BM 449 | Entrepreneurship Development | - | - | - | - | - | - | - |
| **PROJECT** |
| PE 302 | Mini project | 1 | 0 | 0 | 2 | 3 | 60 | 40 |
| PE 401 | Major Project (Stage I) | 2 | 0 |   | 3 | 3  | 60 | 40 |
| PE 402 | Major Project | 3 | 0 |   | 6 |   | 60 | 40 |
| **TRAINING / SEMINAR** |
| PT 401 | Training Seminar | 2 | 0 |   | 3 | 3 | 60 | 40 |
| SM 402 | Seminar | 2 | 0 |   | 3 |   | 60 | 40 |
| **HUMANITIES AND SOCIAL SCIENCES**  |
| HS 201 | Communication Skill | - | - | - | - | - | - | - |
| HS 202 | Cognitive Skill | - | - | - | - | - | - | - |
| HS 301 | Verbal Non-Verbal Reasoning  | - | - | - | - | - | - | - |
| HS 302 | Technical Writing | - | - | - | - | - | - | - |
| HS 401 | Technical Aptitute | - | - | - | - | - | - | - |
| **DISCIPLINE AND EXTRA CURRICULAR ACTIVITIES** |
| DE 101 | Discipline and Extra Curricular Activities – I | 2 | 0 | 0 | 0 | 0 | 100 | 0 |
| DE 102 | Discipline and Extra Curricular Activities – II | 2 | 0 | 0 | 0 | 0 | 100 | 0 |
| DE 201 | Discipline and Extra Curricular Activities – III | 2 |   |   |   |   | 100 |   |
| DE 202 | Discipline and Extra Curricular Activities – IV | 2 |   |   |   |   | 100 |   |
| DE 301 | Discipline and Extra Curricular Activities – V | 2 |   |   |   |   | 100 |   |
| DE 302 | Discipline and Extra Curricular Activities – VI | 2 |   |   |   |   | 100 |   |
| DE 401 | Discipline and Extra Curricular Activities – VII | 2 |   |   |   |   | 100 |   |
| DE 402 | Discipline and Extra Curricular Activities – VIII | 2 |   |   |   |   | 100 |   |
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**DETAIL SYLLABUS**

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15 III Semester**

 **ME201: FUNDAMENTALS OF THERMODYNAMICS C(3,1,0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| --- | --- | --- |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | Basic Concepts and Properties of Pure Substances: System, Properties, State and equilibrium, Processes and cycles, Temperature and pressure, Energy and Environment, Work and heat.Properties of Pure Substance: Definition and laws of ideal gas, phases of pure substances & phase charge processes, property diagrams for phase change processes, Property tables for different state of liquid and vapour, Internal energy, Enthalpy and specific heats of ideal gas, solids and liquids . | 7 |
| **II** | Laws of Thermodynamics: Zeroth law of thermodynamics, temperature scale, First law of thermodynamics, steady flow energy equation, applications of steady flow energy equation, limitations of first law of thermodynamics, second law of thermodynamics , heat engine, Carnot cycle, absolute thermodynamics temperature scale, entropy, change of entropy for different process, equivalence of Kelvin-Planck and Clausius statement, Clausius inequality, second law efficiency and third law of thermodynamics. | 7 |
| **III** | Availability and Thermodynamic Relations: Available and unavailable energy, availability of steady flow and non-flow system. Helmholtz and Gibb’s function, important mathematical relations, Maxwell relations, T-ds relations, Joule-Thomson coefficient, clausius-claperyon equation. | 6 |
| **IV** | Gas Power Cycle: Otto cycle, Diesel cycle, dual cycle, Stirling cycle, Ericsson cycle, Atkinson cycle, Brayton cycle, mean effective pressure and efficiencies, four stroke and two stroke petrol and diesel engine, experimental determination of IHP,BHP and volumetric efficiency. | 6 |
| **V** | Vapor Power Cycle: Rankine cycle, Reheat cycle, Regeneration cycle, co-generation cycle, binary vapor and trinaryvapour power cycle. Calculation at efficiency, work ratio, back-work ratio, specific steam consumption rate, heat consumptions rate for vapor power cycle, vapor compression refrigeration cycle and properties of refrigerants. | 7 |

**List of Recommended Books:**

1. Engineering Thermodynamics, P.K.Nag, Tata McGraw Hill.
2. Engineering Thermodynamics, C.P.Gupta, RajendraPrakashNemi Chand & Bros.
3. Thermal Engineering, Mathur& Mehta.

**ME203 MECHANICS OF SOLID C(3,1,0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **Stress and Strain:** Tension, compression, shearing stress and strain: Poission's ratio; Stress - strain relationship, Hooke's law; Elastic constants and their relations for a isotropic hookean material, anisotropy and orthotropy, thermal stresses, composite bars; simple elastic, plastic and visco-elastic behaviour of common materials in tension and compression test, stress - strain curve. Concept of factor of safety and permissible stress. Bolt, pin, cotter, key etc. subjected to direct stresses. Conditions for equilibrium. Concept of free body diagram; introduction to mechanics of deformable bodies. | 7 |
| **II** | **Members subjected to flexural loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beam. Bending stresses, Section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. | 6 |
| **III** | **Transverse deflection of beams:** Relation between deflection, bending moment, transverse deflection of beams and shaft under static loading area moment method, direct integration method: method of superposition and conjugate beam method. Variational approach to determine deflection and stresses in beam. Application to beam, lever, leaf spring etc. | 7 |
| **IV** | **Principles planes, stresses & strains:** Members subjected to combined axial, bending & Torsional loads, maximum normal and shear stresses; Concept of equivalent bending and equivalent twisting moments: Mohr;s circle of stress and strain.**Theories of Elastic Features:** The necessity for a theory, different theories, significance and comparision, applications. | 6 |
| **V** | **Torsion & Stability of equilibrium:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capicity. Application to helical springs, shaft couplings.Instability and elatic stability. Long and short coloumns, ideal strut, Euler's formula for cripping load for columns of different ends, concept of equivalent length, ecentric loading, Rankine formulae and other empirical relations. Applications like connecting rod, piston rod, screw of screw-jack etc. | 7 |

**List of Recommended Books**

1. Mechanics of Solids: S.H. Crandall, N.C.Dahi&T.J.Lardner, McGraw Hill International Edition
2. Strength of Materials; G.H.Ryder, ELBS Publications Co., London
3. Element of Strength of Materials. J.P.Tinnoshnko&G.H.Young. Affiliated East West Press, New Delhi
4. Solid Mechanics , G.M.A.Kazmi, Tata McGraw Hill Publishing Co.Ltd., New Delhi
5. Machanics of Solids : Dr.AshishDutt Sharma, Vardhan Publication

 **ME-215 AUTOMOTIVE PETROL ENGINE C(3,1,0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **UNIT I ENGINE CONSTRUCTION AND OPERATION** Constructional details of four stroke petrol engine, working principle, air standard Otto cycle, actual indicatordiagram, two stroke engine construction and operation, comparison of four stroke and two stroke engine operation,firing order and its significance. Port Timing, Valve Timing Diagram. | 7 |
| **II** | **UNIT II SI ENGINE FUEL SYSTEM** Carburetor working principle, requirements of an automotive carburetor, starting, idling, acceleration and normalCircuits of carburetors. Compensation, maximum power devices, constant choke and constant vacuum carburetors,Fuel feed systems; mechanical and electrical fuel feed pumps. Petrol injection, MPFI.GDI System, Determination ofair-fuel ratio and numerical problems on air-fuel ratio calculations. | 7 |
| **III** | **UNIT III IGNITION SYSTEM** Types and working of battery coil and magneto ignition systems, relative merits and demerits, centrifugal andVacuum advance mechanisms. Types and construction of spark plugs, electronic ignition systems. Transistorized coil Ignition system, capacitive discharge ignition system | 7 |
| **IV** | **UNIT IV COOLING AND LUBRICATION SYSTEM** Need for cooling system, Types of cooling system: air cooling system, liquid cooling system, forced circulationsystem, pressure cooling system. Lubrication system; mist, wet sump lubrication system, properties of lubricants | 6 |
| **V** | **UNIT V COMBUSTION AND COMBUSTION CHAMBERS** Combustion in SI engine; stages of combustion, flame propagation, rate of pressure rise, abnormal combustion,detonation, effect of engine variables on knock, knock rating. Combustion chambers; different types, factors controllingcombustion chamber design. Engine Management Systems, Performance curves & Evaluation, Emission & EmissionControl, Nano Problems, Heat release analysis. | 7 |

**TEXT BOOKS:**

1. Ganesan. V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.

2. MathurD.S.and Sharma R.P., “A course in Internal combustion engines”, DhanpatRai& Sons Publications, New Delhi, 2001.

3. Ramalingam. K.K., “Internal Combustion Engines”, SciTech Publications, Chennai, 2000.

REFERENCES:

1. Heldt. P.M., “High Speed Combustion Engines”, Oxford IBH Publishing Co., Calcutta, 1975.

2. Obert. E.F., “Internal Combustion Engines Analysis and Practice”, International Text Books Co., Scranton, Pennsylvania – 1988.

3. William H.Crouse, “Automotive Engines”, McGraw-Hill Publishers, 1985.

4. Ellinger. H.E., “Automotive Engines”, Prentice Hall Publishers, 1992.

5. John B.Heywood, “Internal Combustion Engine Fundamental”, McGraw-Hill, 1988.

6. Pulkrabek “Engineering Fundamentals of the Internal Combustion Engines”, Practice Hall of India, 2003

 **AE201: PRODUCTION PROCESSES – I C(3,0,0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 0 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **Mechanics of Metal Cutting:** Elements of a cutting process: geometry of single point cutting tool; tool angles, chip formation; types of chips; chip breakers effects of cutting parameters; Typical cutting speeds and feeds for different tool and job materials; Orthogonal and obligue cutting; Theories of mechanics of metal cutting; cutting force measurement; various types of tool dynameter; thermal aspects of metal machining measurement of chip tool interface temperature; friction in metal cutting.  | 7 |
| **II** | **Metal Joining Processes**: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. Gas welding and cutting: Processes and equipments. Resistance welding: principle and equipments. Spot, projection and seam welding process. Atomic hydrogen, ultrasonic, plasma and laser beam welding, electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings | 7 |
| **III** | **Machine Tools:** Constructional, details and main operation of Center Lathes,.Capstonand Turret Lathe: Shaper and Planner, Drilling and Boring machines, Milling machines, indexing methods. | 5 |
| **IV** | **Powder Metallurgy:** Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M.**Rapid Prototyping Operations:** Introduction, subtractive processes, additive processes, Virtual Prototyping and applications | 6 |
| **V** | **Grinding:** Abrasives: manufacturing and selection of grinding wheels; theory of grinding; characteristic terms used in grinding; classification; constructional features; principle of working; applications and limitations of different grinding machines. Honing, lapping superfinishing, buffing and polishing processes. | 7 |

**List of Recommended Books:**Production Technology by O.P.Khanna, DhanpatRai Publications, New Delhi

1. Workshop Technology, Vol. I by S.K. HazraChoudhary and A.K. HazraChoudhary Media Promotors& Publishers Pvt. Ltd., Bombay
2. Production technology by P.C.SharmaS.Chand& Company Ltd, New Delhi
3. Manufacturing process by Begeman
4. Manufacturing Processes & Material: I.E.Doyle,CarlKayser, Schrade, Leech.
5. Manufacturing Processes, Schey.

 **MA205: ADVANCED ENGINEERING MATHEMATICS C(3,1,0)**

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| **Class B. Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| --- | --- | --- |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | Fourier series: Fourier series, Half-range series, Harmonic analysis.Integral Transforms: Fourier integral theorem, Fourier transforms, Convolution theorems, Inversion theorem for Fourier and Laplace transforms, Simple applications of these transforms to one dimensional problems.  | 7 |
| **II** | Method of separation of variables - applications to the solution of wave equation in one dimension, laplace’s equation in two dimensions, Diffusion equation in one dimension.Transform calculus : Laplace transform with its simple properties, applications to the solutions of ordinary and partial differential equations having constant co-efficient with special reference to wave and diffusion equation.  | 7 |
| **III** | Complex Variable: Functions of a complex variable; Exponential, trigonometric, hyperbolic and logarithmic functions; Differentiation, Analytic functions, Cauchy-Riemann equations, conjugate functions; Application to two dimensional potential problems; Conformal transformations, Schwartz- Christoffel transformation; Cauchy’s Integral theorem. Taylor’s and Laurent’s expansions; Branch points, zeros, poles and residues; Simple problems on contour integration | 7 |
| **IV** | Boundary Value Problems: Equations for vibrations of strings, heat flow and electrical transmission lines; Laplace’s equation in Cartesian, cylindrical polar and spherical polar coordinates; Solution by separation of variables.Solution in Series: Differentiation and integration of infinite series, Series solution of differential equations; Bessel and Legendre equations, their series solution, elementary properties of Bessel functions and Legendre polynomials | 6 |
| **V** | Numerical Methods: Difference operators: forward, backward, central shift and average operators and relations between them. Newton Backward and Interpolation; Lagrange’s interpolation and the error formula for interpolation. Numerical differentiation and integration. Trapezoidal rule and Simpson’s one-third rule including error formula | 7 |

**List of Recommended Books:**

1. Advanced Engineering Mathematics, Kreyszig E., Wiley Eastern
2. Numerical Methods for Scientists and Engineers, Jain M.K., Iyenger S.R.K. Wiley Eastern
3. Theory of Ordinary Differential Equations Coddington, Tata McGraw Hill.
4. Elements of Partial Differential Equations, Ssneddon, Ian N., McGraw Hill
5. Fourier Series & Boundary Value Problems, James Brown and Churchill, Tata McGraw Hill.
6. Maths for Engineers Chandrika Prasad, prasadMudranalaya, Allahabad
7. Advanced Mathmatics for Engineers, Chandrika Prasad, prasadMudranalaya, Allahabad.

**HS 203 ECONOMICS C(L, T, P) = 3(3, 0, 0)**

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| --- | --- | --- |
| **Units** | **Course Contents**  | **Hours** |
| I | Definition of Economics - various definitions, Nature of Economic problem, Production possibility curve Economic laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance | 7 |
| II | Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand. Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.  | 7 |
| III | Various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run. Meaning of Market, Types of Market - Perfect Competition, Monopoly, Oligoply, Monoplistic Competition (Main features of these markets)  | 7 |
| IV | Supply and Law of Supply, Role of Demand & Supply in Price Determinition and effect of changes in demand and supply on prices.  | 7 |
| V | Nature and characteristics of Indian economy (brief and elementary introduction), Privatization - meaning, merits and demerits. Globalisation of Indian economy - merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement | 7 |
|  | Total | 35 |

1. Text Books:
2. 1. Principles of Economics : P.N. Chopra (Kalyani Publishers).
3. 2. Modern Economic Theory – K.K. Dewett (S.Chand

**EE-205 ELECTRO MECHANICAL ENERGY CONVERSION- I C(L.T.P) = 3(3,0,0)**

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| **Unit** | **COURSE CONTENTS** | **Hours** |
| **I** | **Electromechanical Energy Conversion:** Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance. | **6** |
| **II** | **DC generators**: Construction, Types of DC generators, emf equation, lap and wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing mmf, interpoles, characteristics, parallel operation. Rosenberg generator. | **6** |
| **III** | **DC Motors:** Principle, back emf, types, production of torque, armature reaction and interpoles, characteristics of shunt, series and compound motor, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct and indirect test, Swinburne’s test, Hopkinsion test, field and retardation test, single-phase series motor. | **8** |
| **IV** | **Transformers:** Construction, types, emf equation. No load and load conditions. Equivalent circuits, Vector diagrams, OC and SC tests, Sumpner’s back-to-back test, efficiency. Voltage regulation, effect of frequency, parallel operation, autotransformers, switching currents in transformers, separation of losses. | **8** |
| **V** | **Polyphase Transformers:** Single unit or bank of single-phase units, polyphase connections, Open delta and V connections, Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding. | **8** |
|  |  **Total** | **36** |

**References:**

1.) P.S.Bimbhra, Electrical Machinery, 2000, Khanna publishers New Delhi.

2. )J.Nagrath and D.P.Kothari, Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

3. )P.S.Bimbhra, Generalized theory of Electrical Machine, 1996, Khanna publishers, New Delhi.

4. )GopalK.Dubey, Fundamental of Electrical Drives, 2001 Narosa Publishing House, New Delhi

5. )Fitzrald,Kingsley and umans Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

6. ) Advance Electrical Technologies by H.Cotton

 **HS 201 COMMUNICATION SKILLS C(L,T,P)=3(3,0,0)**

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| **Unit** | **Course Contents** | **Hours** |
| 1 | Foundation and background of organizational behaviour, contemporary challenges-workforce diversity, cross – cultural dynamics, changing nature of managerial work, ethical issues at work, emotional intelligence in contemporary business. Perception, Personality, Learning, Motivation – Concepts and applications, individual decision making. | 7 |
| 2 | Understanding and managing group processes-interpersonal & group dynamics, Group cohesiveness, Group decision making Emotional Intelligence-concept and applications, Understanding work teams, power & politics, Empowerment, Conflict & Negotiation. | 8 |
| 3 | Purpose and process of communication; myths and realities of communication; paths of communication; oral communication; noise, barriers to communication; listening process, types of listening, deterrents to listening process, essentials of good listening; telephonic communication. | 6 |
| 4 | Non verbal communication; gestures, handshakes, gazes, smiles, hand movements, styles of working, voice modulations, body sport for interviews; business etiquettes; business dining, business manners of people of different cultures, managing customer care. | 7 |
| 5 | Written communication; mechanics of writing, report writing, circulars, notices, memos, agenda and minutes; business correspondence-business letter format, style of letter arrangement, types of letters, telex managers, facsimiles, electronic mail; diary writing; development resume. | 7 |
|  | Total | 35 |

**Reference Books:**

1. Enrich your English – by CIEFL (Academic Skills book)
2. Contemporary English Grammar – Raymond Murphy
3. Organizational Behavior, - Fred Luthans9thEdition, McGraw-Hill Irwin, 2002.
4. Organizational Behavior, Tenth Edition, TMG, 1998.John W. Newstorm and Keith Davis
5. . Business Communication Today – By Bovee, Thill, Schazman
6. G. Business Communication – by Pal and Korlahalli

**Labs:**

 **ME251: THERMAL ENGINEERING LAB-1 C(L,T,P) = 1(0,0,2)**

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| Experiments1. Comparative study of four stroke diesel and petrol engines.2. Comparative study of two stroke petrol and diesel engines.3. Studies of fuel supply systems of diesel and petrol engines.4. Study of cooling, lubrication and ignition system in diesel and petrol engines.5. To study various types of Boilers and to study Boiler mounting and accessories.6. To study various types of Dynamometers.7. To study Multi Stage Air Compressors.8. To find the BHP, Thermal efficiency of four stroke diesel engine.9. To prepare a comparison sheet of various automobiles (4 Wheeler and 2 Wheeler). |

 **ME253: STRENGTH OF MATERIAL LAB C(L,T,P) = 1(0,0,2)**

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| Experiments1. Izod Impact testing.2. Rockwell Hardness Testing.3. Spring Testing4. Column Testing for buckling5. Torsion Testing6. Tensile Testing7. Compression Testing8. Shear Testing9. Brinell Hardness Testing10. Bending Test on UTM.11. Study of Fatigue Testing Machine. |

 **ME255: PRODUCTION LAB – I C(L,T,P) = 1(0,0,2)**

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| 1.Study of lathe machine, lathe tools cutting speed, feed and depth of cut.2. To perform step turning, knurling and chamfering on lathe machine as per drawing.3. Taper turning by tailstock offset method as per drawing.4. To cut metric thread as per drawing.5. To perform square threading, drilling and taper turning by compound rest as per drawing.6. To study shaper machine, its mechanism and calculate quick return ratio.7. To prepare mould of a given pattern requiring core and to cast it in aluminum.8. Moisture test and clay content test.9. Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).10. Permeability Test.11. A.F.S. Sieve analysis Test. |

 **ME 256 ENGINE TESTING LAB C(L,T,P) = 1(0,0,2)**

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| ENGINE TESTING LAB1. Study of hydraulic, electrical and eddy current dynamometers.2. Valve timing and port timing diagram.3. Performance and emission test on two stroke SI engine.4. Performance and emission test on automotive multi-cylinder SI engine.5. Performance test and emission on automotive multi-cylinder CI engine.6. Retardation test on I.C. Engines.7. Heat balance test on automotive multi-cylinder SI engine.8. Heat balance test on automotive multi-cylinder CI engine.9. Morse test on multi-cylinder SI engine.10. Study of P-θ and P-V diagrams for IC engine with piezo-electric pick up, charge amplifier, angle  |

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15 IV Semester**

**ME-213 KINEMATICS OF MACHINE –I C(3,1,0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

|  |  |  |
| --- | --- | --- |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **UNIT I BASICS OF MECHANISMS** Definitions: Links- Rigid, flexible and fluid links. Kinematic pairs – Degrees of freedom, Kutzbach criterion, Grubler’s criterion (without derivation), Mechanism, structure, Mobility of Mechanism, Kinematic chains and inversions: Grashof’s law – Inversions of Four bar chain; Single slider crank chain and Double slider crank chain. | 7 |
| **II** | **UNIT II KINEMATICS OF LINKAGE MECHANISMS** Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method, Klein’s construction: Analysis of velocity and acceleration of single slider crank mechanism. Coriolis component of acceleration | 7 |
| **III** | **UNIT III KINEMATICS OF CAM MECHANISMS** Types of cams, Types of followers, Terminology and definitions. Displacement diagrams- SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. Graphical construction of Cam profiles- Disc cam with knife-edge, roller, flat-faced followers and oscillating roller follower. | 7 |
| **IV** | **UNIT IV GEARS AND GEAR TRAINS** Spur Gear terminology, law of toothed gearing- involutes and cycloidal tooth profiles – , Path of contact, Arc of contact, Contact ratio, Interference and Methods of avoiding interference in involute gears, Back lash, Comparison of involute and cycloidal teeth. Basics of helical, bevel, worm and rack and pinion gears (Basics only).Simple gear trains,Compound gear trains for large speed reduction, Epicyclic gear trains – tabular methods of finding velocity ratio. | 6 |
| **V** | **UNIT V FRICTION** Introduction – Dry friction – Plate clutches. Belt drives – Flat & V belt drives – Materials used for belts, Velocity ratio, slip, creep. Ratio of driving tensions, angle of contact, centrifugal tension, Maximum tension of belt – power of transmission. | 7 |

TEXT BOOK

1. Rattan.S.S,”Theory of Machines”,,2ndEdition,Tata McGraw Hill Publishers,2005

REFERENCE BOOKS:

1. Ghosh A and Mallick.A.K,“Theory of Mechanisms and Machines”,3

3. Khurmi.R.S&Gupta.J.K, “Theory of Machines”, 15

4. SHIGLEY J.E, “Theory of Machines and Mechanisms”, 2nd Edition, McGraw Hill Inc., 1995rd

 **IV Semester**

 **(AE 208 ) FLUID ENGINEERINC C (L, T, P) = 4(3, 1, 0)**

|  |  |  |
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| **Units** | **Contents of the Subject** | **Hours** |
| **I** | Introduction: Classification of fluids. Properties of fluids. Centre of pressure. Plane and curved surfaces. Buoyancy and stability of floatingbodies. | 7 |
| **II** | Fluid Dynamics: Laws of kinematics of fluid flow. Lagrangian and Eulerian method. Stream function and potential functions. Continuity,momentum and energy equations. Bernoulli’s equations and its applications. Pressure measurements, pitot static tube, venturimeter, andorifice plate. Applications of momentum equations. | 7 |
| **III** | Dimensional Analysis: Buckingham’s theorem, Non-dimensional numbers, similarities of flow. Model studies. | 7 |
| **IV** | Laminar and Turbulent Flows: Reynolds experiments. Flow relation between shear stress and pressure gradient. Flow between parallel plates.Characteristics of turbulent flow. Flow through pipes. Energy losses in pipes. Flow around immersed bodies. | 6 |
| **V** | Fluid Machinery: Principles of operations of centrifugal and axial pumps. Turbo blowers and turbines. Principles and working of gear, vaneand reciprocating pumps. | 7 |
|  | **Total** | **34** |

**List of Recommended Books:**

1. Shames I.H., Mechanics of Fluids, Kogakusha, Tokyo, 1998.

2. Rathakrishnan.E, Introduction to Fluid Mechanics, PrenticeHall, India, 1999.

3. Yuvan.S.W, Foundation of Fluid Mechanics, Prentice Hall, 1998

4. Milne Thomson, L.M., Theoretical Hydrodynamics, McMillan, 1985.

5. Kumar.K.L, Fluid Mechanics, Eurasia Publishing House, 1990.

**IV Semester (AE-212 ) AUTOMOTIVE DIESEL ENGINE C (L, T, P) = 3(3, 0, 0)**

|  |  |
| --- | --- |
| **Class B.Tech IV Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **UNIT I BASIC THEORY** Diesel engine construction and operation, two stroke and four stroke diesel engine, dual cycle engines, dieselcycle, fuel-air and actual cycle analysis, diesel fuel, ignition quality, Cetane number, diesel fuels standards andspecifications. | 7 |
| **II** | **UNIT II FUEL INJECTION SYSTEM** Types of fuel injection system, Requirements, air and solid injection, functions of components, jerk and distributortype pumps common rail system, PTFI system pressure waves, injection lag, unit injector, mechanical and pneumaticgovernors, fuel injector, types of injection nozzle, spray characteristics, injection timing, pump calibration. | 7 |
| **III** | **UNIT III AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS** Importance of air motion, swirl, squish and turbulence, swirl ratio, fuel air mixing, stages of combustion, delayperiod, factors affecting delay period, knock in CI engines. Combustion chamber: design requirements, direct andindirect injection combustion chambers, M type combustion chamber. Introduction -Inlet Manifold, Construction withreference to Efficiency. | 7 |
| **IV** | **UNIT IV SUPERCHARGING AND TURBOCHARGING**Necessity and importance of supercharger, types of supercharging and turbo charging, relative merits, designof Turbo charger Variable Geometrical Techniques, exhaust gas recirculation, charge cooling & Lubrication. | 6 |
| **V** | **UNIT V DIESEL ENGINE TESTING AND PERFORMANCE** Automotive and stationary diesel engine testing and related emission standards. Engine performance and emissionCharacteristics, variables affecting engine performance and emission, methods to improve engine performance, heatBalance, performance maps Engine management systems, CRDI, etc., Performance, Emission, Calculation& Testing of Emissions, Heat Release Analysis. | 7 |

**TEXT BOOKS:**

1. 1. Ganesan. V “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. 2. Mathur D.S. and Sharma R. P. “A course in Internal Combustion Engines”, DhanpatRai and Sons, 2002.

REFERENCES:

1. 1. Ramalingam. K.K. “Internal Combustion Engines Theory and Practice”, SciTech Publications (India) Pvt. Ltd. 2002.
2. 2. Heywood. J.B. “Internal Combustion Engine Fundamentals”, McGraw-Hill Book Co., 1988.
3. 3. Heinz Heister “Advanced Engine Technology”, SAE, 1995.
4. 4. Pulkrabek “Engineering Fundamentals of the Internal Combustion Engines”, Practice Hall of India 2003

**IV Semester( AE-214 ) MOTOR VEHICLE TECHNOLOGY C (L, T, P) = 4(3, 1, 0)**

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| **Class B.Tech V Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 0 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **I.C ENGINES (INTRODUCTION):**Working and difference between SI and CI Engines; Two and four stroke cycles; Theoretical heat cycles : ideal and actual otto and diesel cycle, mixed cycle; Numerical; Working of two and four stroke SI and CI engines; Scavenging methods of two-stroke petrol engines; Comparison of two and four stroke cycle engines.; Auto engines classifications –arrangement of cylinders, valves and camshaft ;Types of fuels used, engine speed, methods of cooling, engine balance; Principle of combustion, detonation and pre-ignition – differences.; Valve timing diagrams – SI and CI, two and four stroke engines. | 7 |
| **II** | **ENGINE PERFORMANCE**: Bore and stroke, swept and clearance volume, compression ratio, effect of C.R, engine torque, mean effective, bmep, bhp, Ihp, fhp; Engine efficiencies – air standard, mechanical, thermal, indicated thermal, brake thermal, volumetric, requirements of high volumetric efficiency, Factors.; Specific fuel consumption; Numerical | 7 |
| **III** | **ENGINE COMPONENT PARTS:** Cylinder block : Types; Crankcase, liners : wet and dry; Gaskets, Timing covers, oil pan, cylinder head; SI engines combustion chambers : types and comparison; CI engine combustion chambers : Direct and Indirect injection, Intake & exhaust ports; lubricating passages; Intake & Exhaust valves and mechanisms; Camshafts: Side & overhead, advantages and disadvantages; Valve seat and conical angles, Valve seat insert, Valve springs, locks, Rocker-shaft, rocker arm, push rod, Cam followers-types; Timing of valves; Intake and exhaust manifold; Mufflers-types; Crankshaft: Nomenclature; Flywheel-functions; Oil seals; Engine Bearings : Thrust, ball, taper roller, needle, split, journal; Bearing materials, properties; Connecting rod; Piston : function, types, materials, piston rings: types, design details, Piston Pins, Component material chart : All engine components. | 7 |
| **IV** | **CHASSIS AND BODY:** Types – unitized and separate body and chassis, Advantages, Designs: chassis frame; Chassis side and cross member, sections and joints; Body: requirements, main parts, Material composition, Body shape aerodynamic design, CD for different types of vehicles; Vehicle component‘s attachments, Front and Rear wheel drive component locations: advantages and disadvantages; Rear mounted engine and rear wheel drive : advantages; Definitions : wheel base, wheel track, minimum radius, front and rear overhang, ground clearance, grade ability, laden and unlade weight; Car seat and seat belt mounting and adjustment. | 6 |
| **V** | **CLUTCH SYSTEM:** Principle, requirements, operation, components of conventional single plate clutch, diaphragm clutch, multiple plate wet clutch, centrifugal clutch; Fluid coupling-characteristics, principle, velocity diagrams, efficiency and torque capacity curves; Comparison of conventional and diaphragm clutch and fluid coupling.Clutch operating systems: rod, cable, hydraulic; Clutch Plate: requirements, construction, material, linings : required properties, types; Numerical; Clutch faults and diagnosis, Clutch pedal free play. | 7 |

**TEXT BOOK**

Crouse, W.H, ―Automobile Technology‖, Tata McGraw Hill

REFERENCE BOOKS

Sethi, H. M, ―Automotive Technology‖, Tata McGraw

**IV Semester( AE-216 ) MACHINE DESIGN C (L, T, P) = 3(3, 0, 0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |

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| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **Limits, Fits and Tolerance:-** Introduction - Tolerance - Fits - Terminology standard tolerances, positioning of tolerances - Fundamental deviation selection of tolerance Zones, selection of Fits, Methods of indicating fits on drawings  | 7 |
| **II** | **Shafts couplings & Bearings: -** Introduction - Rigid or Fast coupling - Non Rigid of flexible couplings, couplings for shafts out of alignment loose or disengagement couplings. Bearings: Ring oiled Bearing, Swivel Bearing, Anti-friction Bearings  | 7 |
| **III** | **Workshop tools and equipment: -** Lathe machine, drilling machine, shaper machine , shaper tool head, Machine swivel vice. Difference between Jigs and Fixtures  | 6 |
| **IV** | **Materials& Manufacturing aspects in Design:** Properties and IS coding of various materials, Selection of materials from properties and economic aspects. Selection of manufacturing processes on the basis of design and economy, influence of rate of production, standard size, influence of limits, fits, tolerance of and surface finish. Change in the shape of the designed element of facilitate its production, Design of castings, working drawing | 6 |
| **V** | **Design for strength: -** Allowable stresses, detailed discussion on factor of safety (factor of ignorance): Stress concentration, causes and mitigation. Introduction of various design considerations like strength, stiffness, weight, cost, space etc., concept of fatigue failures. | 7 |

**List of Recommended Books:**

1. Machine Drawing: V. Lakshminarayan& M.L Mathur, Jain Brothers, N. Delhi
2. Machine Drawing: P.S.Gill, S.K.Kataria& Sons, N.Delhi
3. Machine Drawing: N. Sidherwar, P.Kannaiah, VVS Sastry, Tata McGraw Hill Publishing Co. Ltd.
4. Production Drawing: K.L.Narayana, P.Kannaiah&K.Venkata Reddy., New Age International (P) Ltd.
5. Machine Drawing: R.K. Dhawan, S.Chand& Co. Ltd. N. Delhi
6. Elements of Machine Design, N.C.Pandya&C.S.Shah, Charotar Book Stall, Anand.
7. Design of Machine Elements; V.B.Bhandari, Tata McGraw Hill Publishing Co. Ltd.
8. 'Mechanical Machine Design; R.C.Bahl&V.K.Goyal, Standard Publishing Distributors, Delhi
9. 'Mechanical Engineering Design; J.E.Shigley,McGraw Hill Book Co.

**IV Semester ( EC- 256 ) ELECTRONICS ENGINEERING C (L, T, P) = 3(3, 0, 0)**

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| **Class B.Tech III Sem.** | **Evaluation** |
| Schedule per weekLectures : 3Tutorial : 1 | Examination Time = Three (3) HoursMaximum Marks = 100[Mid-term(30) & End-term (70)] |
| **Units** | **Contents of the Subject** | **No. of Hours. required** |
| **I** | **HISTORICAL BACKGROUND:** Vacuum tubes; working of vacuum tube and their characteristics; Vacuum diode; triode; tetrode and pentode PN JUNCTION: Depletion layer; Barrier potential; Forward and reverse bias; Breakdown voltage; PIV; switching characteristics of p-n junction diode; knee voltage; load line; and operating Point Ideal p-n junction diode; junction capacitance; zener diode. | 7 |
| **II** | **. RECTIFIERS AND FILTERS**: Half wave; centre tap full wave and bridge rectifier; percentage of regulation; PIV; ripple factor; C; RC; LC and PI filter; voltage doubler; clipping and clamping circuit; voltage regulation. | 7 |
| **III** | **BIPOLAR JUNCTION TRANSISTOR:**Introduction; basic theory of operation of PNP ad NPN transistor-l characteristics; CB; CE and CC configuration | 7 |
| **IV** | **FET: Introduction**; Theory of operation; JFETParameters; and JFET Amplifiers. MOSFET: Introduction; theory of operation; MOSFET parameters; application; graphical analysis of BJT and FET circuits; linear models of BJT and FET;pulse and large signal models of BJT and FET | 6 |
| **V** | **. BIASING TECHNIQUES OF FET:**Introductory idea of multistage and feedback amplifiers; base bias; emitter feedback bias; collector voltage divider bias; Load line and operating point. INTEGRATED CIRCUIT: Analysis of principle of integration. Introduction to Digital Integrated circuits; THYRISTORS: Introduction to thyristor family; SCR theory of operation; SCRcharacteristics and triggering; TRIAC: Theory of operation; Characteristics and control by SCR and TRIAC Introduction to op-amp; UJT: Introduction; Basic theory of operation characteristics and structure; Complementary and programmable UJT relaxation oscillator. | 7 |

**TEXT BOOK**

Millman and Halkias, ―Electronic Devices and Circuits‖,

2nd Edition, Tata McGraw Hill, 2000

REFERENCE BOOKS

1. Millman and Halkias, ―Integrated Electronic‖, Tata McGraw Hill, 3rd Edition, 2001.

2. Boylestad and Nashelsky, ―Electronic Devices and Circuits‖, 4th Edition, Pearson Education, 1999.

3. Malvino, ―Electronic Principles‖, 5th Edition, Tata McGraw Hill, 2004.

4. Bell David A., ―Electronic Devices and Circuits‖,3rd Edition, Prentice Hall of India, 2007

5. Bhargave N. N., ―Basic Electronics and Linear Circuits‖, Tata McGraw Hill, 2007

**IV Semester ME 212 INSTRUMENTATION AND CONTROL C (L, T, P) = 3(3, 1, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | System configuration, basic characteristic, calibration, classification and performance characteristics of a instrumentation system, Specification and testing of dynamic response.Strain Measurement : Electric Strain Gauges - Types ; Selection and Installation, Strain gauge circuits; temperature compensation and calibration; Use of Strain Gauges on Rotating Shafts, Load Cells, Mechanical and Optical Strain Gauges. | 7 |
| **II** | Various Mechanical, Electro- Mechanical & Photoelectrical Sensors for sensing ofDisplacement, Velocity, Acceleration, Torque, Force, Temperature from Low to High Range, flow, level of fluid , pressure, angular speed, voltage, frequency and current.Introduction to Multi-Channel Data-Acquisition System, Measurement Pods, Interface Hardware, Data Analysis Software, Interfacing. | 7 |
| **III** | Concepts and examples of automatic control systems, systems by differential equations, transfer function, block diagram, open and feedback control systems, signal flow graphs & its constructions. Control System components, error sensing devices and servo motors. | 7 |
| **IV** | Control for mechanical systems &processes ; speed control system for steam/gas turbines. A constant tension ;reeling system, Electro-mechanical systems. Thermal systems, Pneumatic systems; Mathematical Models of physical systems, Feedback characteristics of Control Systems.Time response analysis; transient response analysis, time response specifications, steady state-error. | 7 |
| **V** | Concepts of stability, Routh-Hurwiz stability criterion, relative stability. The root locustechnique, use of construction rules without any derivation.Frequency response analysis, Polar plots; stability in frequency domain, Bode / Logrithmic plots. Nyquist stability criterion. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Mechanical Measurements and Instrumentation, A.K. Sawhney, PuneetSawhney, DhanpatRai
2. Mechanical Measurements, Thomas G. Backwith, N. Lewis Buck, Roy, D., Marangoni, Narosa Publishing House
3. Industrial Instrumentation and Control, S.K.Singh, Tata McGraw Hill
4. Control Systems Engineering; I.J.Nagrath&M.Gopal, Wilay Eastern Limited

Automatic Control Engineering; Raxen, McGraw Hill, International Edition

**EE204 ELECTRO MECHANICAL ENERGY CONVERSION–II C(L,T,P) = 3(3,0,0)**

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| **UNIT** | **COURSE CONTENTS** | **Hours** |
| **I** | **Introduction:** General equation of inducted emf, AC armature windings: concentric and distributed winding, chording, skewing, effect on induced emf. Armature and field mmf, effect of power factor and current on armature mmf, harmonics. Rotating fields. | **6** |
| **II** | **Induction Motors:** Construction of squirrel cage and slip ring induction motor, basic principles, flux and mmf waves, induction motor as a transformer. Equivalent circuits, torque equation, torque-slip curves, no load and block rotor tests, circle diagram, performance calculation. Effect of rotor resistance. Cogging, Crawling. Double cage squirrel cage induction motor, induction generator, induction regulator. | **6** |
| **III** | **Starting and Speed Control of Induction Motors:** Various methods of starting and speed control of squirrel cage and slip ring motor, cascade connection, braking.**Single-Phase Induction Motor:** Revolving field theory, starting methods, equivalent circuits. | **8** |
| **IV** | **Synchronous Generator:** Construction, types, excitation systems, principles. Equation of induced emf, flux and emf waves, theory of cylindrical rotor and salient pole machines, tworeactance theory, phasor diagrams, power developed, voltage regulation, OC and SC tests, zero power factor characteristics, potier triangle and ASA method of finding voltage regulation, synchronization, parallel operation, hunting and its prevention. | **8** |
| **V** | **Synchronous Motors:** types, construction, principle, phasor diagrams, speed torque characteristics, power factor control, V-curves, starting methods, performance calculations, applications, synchronous condenser, synchronous induction motor. | **8** |
|  | **Total** | **36** |

**References:**

1) P.S.Bimbhra, Electrical Machinery, 2000, Khanna publishers New Delhi.

2) J.Nagrath and D.P.Kothari, Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

3) P.S.Bimbhra, Generalized theory of Electrical Machine, 1996, Khanna publishers, New Delhi.

4) GopalK.Dubey, Fundamental of Electrical Drives, 2001 Narosa Publishing House, New Delhi

5) Fitzrald,Kingsley and umans Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

**HS 202 CONGNITIVE SKILLS C (L,T,P)=3(3,0,0)**

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| **Units** | **Contents of the Subject**  | **Hours** |
| 1 | Introduction to Mindfulness, Mindfulness Exercise, DBT Life Skills – Distress Tolerance | 8 |
| 2 | Mindfulness Exercise, DBT Life Skills – Emotion Regulation | 8 |
| 3 | Mindfulness Exercise, DBT Life Skills – Interpersonal Effectiveness | 7 |
| 4 | Mindfulness Exercise, Anxiety Disorders, Depression, and Personality Disorders, Acceptance: Living in the Here-and-Now as a Way of Life | 7 |
| 5 | Mindfulness Exercise, Introduction to Dialectical Behavior Therapy (DBT), Dialectic Philosophy, Wise Mind | 7 |
|  | **Total** | **37** |

**Reference Books:**

1. ShivaniD.R. (1998): NGO Development Initiative & Policy – Vikas Publications

**LAB**

 **IV Semester ( EC- 256 ) ELECTRONICS ENGINEERING LAB C(L,T,P) = 1(0,0,2)**

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| 1. Study V-I characteristics of diode; and its use as a capacitance. 2. Study of the characteristics of transistor in Common Base configuration.3. Study of the characteristics of transistor in Common Emitter configuration.4. Study of V-I characteristics of a photo-voltaic cell.5. Study of characteristics of MOSFET/JFET is CS configuration.6. Plot characteristics of thyristor.7. Plot characteristics of UJT.8. Plot characteristics of diac and Triac.9. Introduction to Orcad PSPICE Software.10. Simulation of semiconductor device circuits using Orcad PSPICE |

**AE 355 KINAMICS OF MACHINE LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. To verify the relation T= I. ω. ωp for gyroscope.2. To plot force v/s radius and lift v/s speed curves for governors.3. To plot pressure distribution curves on a journal bearing.4. To perform wheel balancing and wheel alignment test.5. To perform static and dynamic balancing on balancing setup.6. To determine mass moment of inertia of a fly wheel.7. Study of a lathe gear box.8. Study of a sliding mesh automobile gear box.9. Study of planetary gear box.10. Study of single suspension Test , seat Dynamic Test.11. Study of ride comfort test system , noise measurement system.12. Study of damping material effectiveness measurement system , Various Hydraulicand electromechanical actuator. |

 **IV Semester ( AE 256 ) Fluid Engineering Lab.. C (L, T, P) = 1(0, 0, 2)**

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| 1. Determine Metacentric height of a given body.2. Determine Cd, Cv& Cc for given orifice.3. Determine flow rate of water by V-notch.4. Determine velocity of water by pitot tube.5. Verify Bernoulli’s theorem.6. Determine flow rate of air by Venturi meter7. Determine flow rate of air by orifice meter8. Determine head loss of given length of pipe.9. Determine flow rate of air by nozzle meter. |

**IV Semester (AE-260 ) MOTOR VEHICLE TECHNOLOGY LAB C(L,T,P) = 1(0,0,2)**

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| **LIST OF EXPERIMENTS** 1. Identify, write specifications and draw sketches of i) General Tools ii) Measuring Tools iii) Special Tools used in an automobile workshop and Practice to use them. 2. Identify various assemblies and sub assemblies of an automobile chassis. Draw layout and explain function of each unit. 3. Study of 4 stroke C.I and S.I engines. Draw Sketches and explain the function of each component. 4. Study of 2 stroke S.I engine. Draw Sketch and explain the function of each component. 5. Study the Cooling System of an Automotive Engine sketch the various components and explain function of each. 6. Identification of components of single plate, multi plate clutch system. Draw sketch and explain function of each component. 7. Identifications of components of sliding mesh constant mesh and synchromesh gear box. Draw power flow diagrams at various speeds. 8. Identify and give functions of each component of differential and rear axle assembly. 9. Study construction of different types of Automobile wheels and tyres and draw their sketches. 10. Study the propeller Shaft, Slip joint and universal Joints of a Vehicle. Draw sketches and label various components parts.  |

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15V Semester**

**AE 301 HEAT TRANSFER IN IC ENGINE C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **Introduction of heat transfer:** Temperature, heat and thermal equilibrium, basic definition and law of heat transfer, modes of heat transfer, steady and unsteady heat transfer, and significance of heat transfer. **Conduction Heat Transfer**: Fourier equation, general heat conduction equation: Cartesian co-ordinate, cylinder co-ordinate, spherical co-ordination, conduction through plane wall, composite wall cylindrical, multi cylindrical wall, spheres. Critical thickness of insulation, heat transfer from extended surface , steady state flow of heat along a rod, governing differential equations and their solution, heat dissipation from infinite long fin, insulated tip , fin performance . | 7 |
| **II** | **Convection**: Stroke energy equation, hydrodynamic and thermal boundary layers: laminar boundary layer equation; forced convection appropriate non dimensional members, flow over flat plate, similarity solution. Von-karman’s method, effect of Prandtl number. Laminar flow through circular pipe. **Natural Convection**: Dimensional analysis Grashoff number, boundary layers in external flow (flow over a flat plate only), boundary layer equations and their solutions. Heat transfer Correlation. | 7 |
| **III** | **Radiation:** Salient features and characteristics of radiations, absorptive, reflectivity and transmissivity, spectral and spatial energy distribution, wavelength distribution of black body radiation, planck’s law. Total emission power. Stefan Boltzman law, Wien‘s displacement law,kirchoff’s law , intensity of radiation & Lambert’s consine law. | 7 |
| **IV** | **Heat transfer in IC engine:** Water and air cooling of engines, combustion systems and variation of gas temperatures, heat transfer coefficients, calculations of heat rejection to coolant. Heat transfer, temperature distribution and thermal stress in piston, piston ring, cylinder liner. Heat transfer through cylinder head, fins and valves, Effect of various operating parameter on engine heat transfer. | 7 |
| **V** | **Heat exchangers used in IC engine :** Principles of different type of Heat exchanger. Type of radiators , inter cooler and after cooler . EGR cooling and EGR coolers. Engine coolant and their properties. | 7 |
|  | **Total** | **35** |

**AE 303 AUTOMOTIVE ELECTRICAL AND ELECTRONICS C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **Storage Batteries**: Principles, construction and operation of lead acid battery, battery capacity, efficiency, rating and performance. Determination of battery size. Electrolyte, Battery tests, Battery charging equipment and methods. Battery faults. | 7 |
| **II** | **Starter and charging system:** Starting system requirements, sizing of starter motor and selection, characteristics of starter motor, type of starting, motor drive mechanisms, starter switch, starter system fault. DC Generator & AC alternators. Magneto. Armature reaction, cut out relay, voltage and current regulator system for generator and alternators. | 7 |
| **III** | **Auxiliary systems:** Types of lamps used in automobile, head light, tail light, fog lights, brake light, side indicator, parking and other indicating lights. Principle of automotive illumination, dash board lights, indicators and meters, speedometers, electric horn, wind shield wiper, heaters & defrosters, electric horn and relay devices, Different types of gauges and indicators. Electrical fuel pump. | 7 |
| **IV** | **Ignition system:** Working of coil ignition system and its components, spark advance mechanisms, limitations of coil ignition systems. Advantages of electronic ignition systems, types of solid state ignition systems and their principle of operation. Contact less electronic ignition system, electronic spark timing ands its control. | 7 |
| **V** | **Automotive sensors:** Description and working of different engine and vehicle sensors such as speed sensor, tyre pressure sensor, oxygen sensors, fuel level sensor etc. | 7 |
|  | **Total** | **35** |

**AE 306 DESIGN OF MACHINE ELEMENTS II C (L, T, P) = 4(3, 1, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Fatigue Considerations in Design: Variable load, loading pattern, Endurance stresses, influence ofsize, surface finite, notch sensitivity & stress concentration, Goodman line, soderberg, design ogmachine members subjected to combined, steady and alternating stresses. Design of finite life.Design of shafts under Variable Stresses.Design of Springs:Helical compression, torsional and leaf springs. Springs under Variable Stresses. | 7 |
| **II** | Design of Bolts: Preloading of bolts; effects of initial tension and applied load bolts subject tovariable stresses.Design of weldments: welds subjected to eccentric loading and combined stresses.Design of curved members: Crane hook, body of C-clamp, machine frame etc | 7 |
| **III** | Design of flywheelsDesign of belt, rope and pulley drive system, chain & sprocket drive systems. | 7 |
| **IV** | Design of Gear: lewis and Buckkhingam equations; wear and Dynamic load considerations, designand force analysis of spur, helical, beval and worm analysis of spur, helical, bevel and worm gears.Bearing reactions due to gear tooth forces, | 7 |
| **V** | Design of sliding & journal bearing: method of lubrication, hydrodynamic, hydrostatic, boundaryetc. Minimum film thickness and thermal equilibrium.Selection of anti-friction bearings for different loads and load cycle Mounting of the bearings.Methods of lubrication, selection of oil seals. | 7 |

**AE 307 AUTOMOTIVE TRANSMISSION C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **Transmission requirements:** Requirements of transmission system, general arrangementsfor power transmission for front engine, rear engine vehicle, four wheel drive vehicle, deadaxle and axle less transmission.**Clutch:** Single plate, multi plate clutch, centrifugal clutch, electromagnetic clutch,constructional details, torque capacity and clutch friction materials. | 7 |
| **II** | **Gear box:** Requirements of gear box, sliding mesh gear box, constant mesh gear box,synchromesh gear box, epicyclic gear box, velocity ratio and gear ratio for vehicle,performance characteristics in different speed , overdrive. | 7 |
| **III** | **Hydrodynamic drive:** Fluid Coupling : principle of operation, constructional details,torque capacity and performance curve.**Torque converter** : principle of operation, constructional details, torque capacity andperformance curve. Multistage torque converter, converter fluid | 7 |
| **IV** | **Hydrostatic drive:** Various types of hydrostatic system, working principle of hydrostaticsystem, advantage and limitations, Jenny hydrostatic drive, comparison of hydrostatic andhydrodynamic drive.**Electric drive:** Principle of electric drive, Early ward Leonard control system, ModifyLeonard control system, advantage of electric drive, limitation of electric drive. | 7 |
| **V** | **Automatic Transmission:** Need for automatic Transmission, Chevrolet turbo glidetransmission system, torque flite, Automatic transmission fluid, effect of automatictransmission on vehicle performance and fuel economy. | 7 |
|  | **Total** | **35** |

**AE 311 KINEMATICS OF MACHINE II C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **INTRODUCTION:** Mechanisms and Machines: Kinematics links; pairs; chains; Kinematics i.nversions; Four bar planer mechanisms; mobility and range of movement; Miscellaneous mechanisms; (straight line; steering; pantograph)  | 7 |
| **II** | **KINEMATIC SYNTHESIS OF MECHANISMS:** Type; number and dimensional synthesis; function generation /Path generation/position generation; two and three position synthesis of four bar/Slider crank mechanisms by graphical and analytical methods; Freudenstein‘s equation; precision positions; structural error; Chebychev‘s spacing; Transmission angle  | 7 |
| **III** | **CAMS:** Classification of cams and followers; disc cam nomenclature; Construction of displacement/velocity/acc; for different types of follower motions; Synthesis of cam profile by graphical and analytical approaches; Cams with specified contours/ tangent and circular arc cams  | 7 |
| **IV** | **BALANCING OF ROTATING COMPONENTS**: Static/dynamic balancing; Balancing of rotating masses; Two plane balancing-graphical and analytical methods; balancing of rotors; field balancing; balancing machines  | 7 |
| **V** | **BALANCING OF RECIPROCATING PARTS**: Balancing of single cylinder engine; balancing of multicylinder - inline/radial/V-type engines; firing order  | 7 |
|  | **Total** | **35** |

**TEXT BOOK** Rattan, S. S., ―Theory of Machines‖, Tata McGraw Hill, 2nd Edition, 2007

**REFERENCE BOOKS**

1. Shigley, J. E., ―Theory of Machines and Mechanisms‖, Oxford, 3rd ed, 2009

2. Rao, J. S, and Dukkipatti., ―Mechanism and Machine Theory‖, New Age International

**ME 313 FACILITIES PLANNING & MATERIAL HANDLING C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Plant Location: The ideal location. Proximity to market. Proximity to raw materials, Transportation costs. The labour supply. electric power. Water and land costs. Local Taxes. Security from attack. Specialised communities, Climate, Urban, Suburban, and small town locations, Plant location trends, Best location for small plants. Incentive offered by State Government for dispersal of industries. Planned Industrial centres Government industrial estate - public sector plants and their location, growing competition for industry amoung states to locate in their midst. centralisation v/s decentrlisation - decentralisation by horizontal and vertical methods. soures of information concern in location. Moving to a new location. Moving costs. To lease or buy or build an industrial plant.  | 7 |
| **II** | Plant Location techniques: Euclidean distance, squared euclidean distance, rectilinear distance, linear distance methods, Prolems on multi-location. Plant layout: introduction to plant design, types of manufacturing processes. Plant location, influence of location on layout, Industrial Buildings. Influences of Buildingon Layout, Classical types of layout product layout and Process layout and practical layouts. | 7 |
| **III** | Planning the Layout: Various operational Research techniques for balancing of assembly lines, Fabrication line balancing. Safety Engineering; Safety in Machine shop, forging shop, carpentry shop, welding shop and foundary shop. safety in critical storage area. storing explosive materials, gases and inflammable liquids. | 7 |
| **IV** | MATERIAL HANDLING: Types of materials handled in an engineering plant, basic principles of material handling. Engineering and economic factors. Classifications of material handling equipment's according to operating principle, construction and nature of service. Gravity equipment's - Chutes, belt and rolling conveyers. Gravity roller spirit's Fixed systems of power driven conveyers, Belt, chain slot, apron, wire aush, Pellet, roller flight, cross bar and chain trolley type of conveyers, Arm, vertical Belt and suspended tray type of elevatos, reciprocation elevators industrial elevators, screw conveyers, ribbon conveyers, bucket elevators, etc. Skip hoists, drag scrapers, tramways and cableways, Pneumatics and hydraulic conveyers. | 7 |
| **V** | Cranes ; jib electric overhead travelling (E.O.T.), cantilever cranes. Track systems; Overhead track of onorail system. Industrialrailways,locomotivecranes.Portable conveyers; Hand trucks, Forkit trucks. Container system of transport; Unit loads, riteriaetion of unit load riteria Co-ordination of handling with production; copntinous, riteriae and intermittent type. Applicationof time and motion study. Organisational and selection of material handling system. Operation, maintenance, and safety precaution Selection of plant layout from material handling riteria. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Practical Plant Layout, Muther, McGraw Hill
2. Plant Layout & Design, Immer, McGraw Hill
3. Material Handling, Immer, McGraw Hill
4. Facilities Planning, Tomphins James A & White John Wiley & Sons.
5. Facility Layout & Location, Francis R.C. & White J.A.Prentice Hall.

**EC 317 PRINCIPLE OF COMMUNICATION SYSTEMS C(L,T,P) = 3(3,0,0)**

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| **Units** | **Course Contents**  | **Hours** |
| 1 | **Noise Effects in Communication Systems:** Resistor noise, Networks with reactive elements, Noise temperature, Noise bandwidth, effective input noise temperature, Noise figure. Noise figure and equivalent noise temperature in cascaded circuits | 7 |
| 2 | **Amplitude Modulation:** Frequency translation, Recovery of base band signal, Spectrum and power relations in AM systems. Methods of generation and demodulation of AM-DSB, AMDSB/ SC and AM-SSB signals. Modulation and detector circuits for AM systems. AM transmitters and receivers. | 7 |
| 3 | **Frequency Modulation:** Phase and freq. modulation and their relationship, Spectrum and bandwidth of a sinusoidally modulated FM signal, phasor diagram, Narrow band and wide band FM. Generation and demodulation of FM signals. FM transmitters and receivers, Comparison of AM, FM and PM. Pre emphasis and de-emphasis. Threshold in FM, PLL demodulator.  | 7 |
| 4 | **Noise in AM and FM:** Calculation of signal-to-noise ratio in SSB-SC, DSB-SC, DSB with carrier, Noise calculation of square law demodulator and envelope detector. Calculation of S/N ratio in FM demodulators, Super-heterodyne receivers.  | 7 |
| 5 | **Pulse Modulation Systems:** Sampling theorem, Generation and demodulation methods of PAM, PWM, PPM.  | 7 |
|  | Total | 35 |

**HS 301 VERBAL & NON-VERBAL REASONING C(L,T,P)=3(3,0,0)**

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| **Units** | **Course Contents**  | **Hours** |
| 1 | [Logical Sequence of Words](http://www.indiabix.com/verbal-reasoning/logical-sequence-of-words/), [Blood Relation Test](http://www.indiabix.com/verbal-reasoning/blood-relation-test/), [Syllogism](http://www.indiabix.com/verbal-reasoning/syllogism/) | 7 |
| 2 | [Series Completion](http://www.indiabix.com/verbal-reasoning/series-completion/), [Cause and Effect](http://www.indiabix.com/verbal-reasoning/cause-and-effect/), [Dice](http://www.indiabix.com/verbal-reasoning/dice/) | 7 |
| 3 | [Venn Diagrams](http://www.indiabix.com/verbal-reasoning/venn-diagrams/), [Cube and Cuboids](http://www.indiabix.com/verbal-reasoning/cube-and-cuboid/)[Analogy](http://www.indiabix.com/verbal-reasoning/analogy/) | 7 |
| 4 | [Seating Arrangement](http://www.indiabix.com/verbal-reasoning/seating-arrangement/), [Character Puzzles](http://www.indiabix.com/verbal-reasoning/character-puzzles/), [Direction Sense Test](http://www.indiabix.com/verbal-reasoning/direction-sense-test/) | 7 |
| 5 | [Classification](http://www.indiabix.com/verbal-reasoning/classification/), [Data Sufficiency](http://www.indiabix.com/verbal-reasoning/data-sufficiency/), [Arithmetic Reasoning](http://www.indiabix.com/verbal-reasoning/arithmetic-reasoning/), [Verification of Truth](http://www.indiabix.com/verbal-reasoning/verification-of-truth/) | 7 |
|  | Total | 35 |

**Reference Books:**

‘Reasoning’ by R.S. Aggarwal

**LAB**

**ME 254 MACHINE DESIGN LAB C (L, T, P) = 2(0, 0, 3)**

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| **LIST OF EXPERIMENTS** 1. Selection of material & IS coding 2. Selecting fit & assigning tolerances 3. Examples of Production considerations.**Problems on** 1. Knuckle & Cotter joints
2. Torque: Keyed joints & shaft couplings
3. Design of screw fastening
4. Bending: Beams, Levers etc.
5. Combined stresses: Shafts, brackets, eccentric loading
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**AE 351 THERMAL ENGINEERING LAB – II C (L, T, P) = 1(0, 0, 2)**

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| 1. For Given apparatus determine :a. Thermal conductivity of given insulating powder.b. Critical thickness of insulation.c. Thermal resistant of insulating powder five parts.d. To plot theoretical temperature profile by dividing the thickness in minime. State all assumption applied in above calculation2. To find emmisivity of a grey body relative to a given black body and to find out theStefan Boltzman constant.3. To perform the experiments on pin fin test rig in forced convection by neglectingradiation losses and to calculate:a. Convective heat transfer coefficient. (Experimentally & using empiricalcorrelation).b. Efficiency, Effectiveness.c. Comparison of experimental & theoretical temperature profiled. Heat the same exercise by considering radiation losses.4. To find the connective heat transfer coefficient of a given cylinder in verticalposition by neglecting radiation losses by assuring.a. Constant surface temperature.b. Constant heat flux & compare with experimental heat transfer coefficient by neglecting radiation losses & by considering radiation losses.5. Perform the experiment No. 4 by using cylinder in horizontal position.6. To find the overall heat transfer coefficient of parallel flow / Counter flow HeatExchanger.7. To determine the efficiency and effectiveness of an automobile radiator. |

**AE 353 AUTOMOTIVE ELECTRICALS AND ELECTRONICS LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Study of different type of Battery construction and different battery test.2. Study of different automotive electrical system (Starting system, Ignition system,lighting system, wiring harness.)3. Assembling and dismantling of Starter motor used in automobile.4. Assembling and dismantling of alternator used in automobile.5. Trouble shooting with Ignition system.6. Study of different color code system used in automotive wiring system.7. Study of different Electrical Equipments& Accessories ( Speedometer, Warning lights , Electric Horn , Wind shield wipers system )8. Study of different sensor used in modern automotive system.9. Study of various electronics system ( Electronic fuel injection system, Electronicignition system , Air bag , ABS , lectronic fuel injector cleaner). |

**AE 357 AUTOSHOP PRACTICE LAB C (L, T, P) = 1(0, 0, 2)**

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| **LIST OF EXPERIMENTS** 1. Identification and specifications of standard and non standard tools and garage equipments used in an Automobile repair workshop. 2. Wet / Dry servicing of a vehicle which includes washing; cleaning; changing engine oil; oil filter; air filter and fuel filter and engine tuning. 3. Dismantle clutch assembly from a vehicle; Inspect and replace defective parts; reassemble and adjust clutch free play. 4. Overhaul gear box and propeller shaft with U J Cross of Maruti vehicle. 5. Study the steering geometry of a vehicle. Carry-out wheel balancing and wheel-alignment of vehicle. 6. Remove punctured tyre from vehicle; repair the puncture; and do tyre rotation 7. Overhaul master cylinder (Single and Tandem) of hydraulic brake system of vehicle and do bleeding operation. 8. Overhaul front suspension of Maruti Vehicle. 9. Remove engine from Maruti vehicle; dismantle engine; clean its components and (A) Inspect engine for damaged/defective and worn out parts. (i) Water jackets; (ii) oil galleries; (iii) cracks;(iv) main and big end bearings; (v) crankshaft (vi) cam shaft;(vii) connecting rod(vii) timing gears etc. (B) Measurement and recording of: (i) Cylinder bore dimensions; its ovality; taper and wear (ii) Ovality; taper and wear of crankshaft; (iii) Connecting rod alignment; inspect the components for wear and tear; (iv) Engine cylinder ridge cutting; boring and honing. 10. Reassemble the Engine and mount engine on the vehicle.  |

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15 VI Semester**

 **AE 302 AUTO CHASSIS AND AUTO SYSTEM DESIGN C (L, T, P) = 4(3, 1, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Introduction of Auto System Design: Aspects of Auto Design, Design Procedure, Principleof Design, Classification of design, Basic requirements of design, Quality of DesignEngineer.Automotive chassis and chassis frame: general considerations related to chassis layout,power plant location, weight distribution, stability, types of frame, materials, calculation ofstresses on sections construction details, loading points, testing of frames in bending andtorsion | 7 |
| **II** | Design of IC Engine Parts: General considerations of Engine Design, Principle ofSimilitude, and Design of Engine Components like: Piston, Cylinder, Connecting rod,Crank shaft, Valves. | 7 |
| **III** | Design of Clutch: Types of friction clutches, requirements of clutches, general designconsideration, design the equation for power transmitted through single plate and multiplate clutch for Uniform wear and uniform pressure, design for dimensions of clutch,equation for centrifugal clutch. | 7 |
| **IV** | Design of Brake: General design considerations, braking efficiency, braking torque on theshoe, effect of expanding mechanism of shoes on braking torque, braking of vehicle fortwo wheel drive and four wheel drive, braking of vehicle for curved path calculation ofmean lining pressure and heat generation during brake operation. | 7 |
| **V** | Design of Suspension System: Function suspension system in automobile, design of helicalcoil spring, leaf spring, materials for spring, standard sizes of automobile suspensionspring.Propeller Shaft: Design of Propeller shaft, Design of universal Joint. | 7 |
|  | **Total** | **35** |

**AE 304 AUTOMATIC CONTROL ENGINEERING C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Introduction: Concepts of automatic controls, open and closed loop systems, concept offeedback control. Requirements of an ideal control system.Differential equations for mechanical systems, transnational and rotational systems,Electrical systems such as servos, D.C. motors, A.C. Servomotors, Hydraulic systems,hydraulic servos meters, thermal systems, integrating devices, temperature control systems,error detection. | 7 |
| **II** | Systems Response: First and second order system response to step, ramp and sinusoidalinputs. Concept of time constant and its importance in speed response. Response of asystem to an external disturbance. Mathematical concept of stability. Routh’s Hurwitzcriterion. | 7 |
| **III** | Block diagrams, Signal Flow Graphs and Transfer Function: Definition of transferfunction, block representation of system elements. Reduction of block diagrams and signalflow paths, Basic properties, signal flow graphs, gain formula to block diagrams. | 7 |
| **IV** | Frequency Response: Polar and rectangular plots for frequency response. Experimentaldetermination of frequency response. System analysis using Niquest diagrams, relativestability, concept of margin gain and phase margin. M & N cycles. | 7 |
| **V** | Systems Analysis: Systems Analysis using logarithmic Plots: Bode attenuation diagrams,Stability analysis using Bode diagrams, Simplifies Bode diagrams; Systems Analysis usingRoot Locus Plots: Definitions of root locus plots and root loci. Graphical relationship,setting systems gain. System Compensation | 7 |
|  | **Total** | **35** |

**ME 311 MECHANICAL VIBRATION AND NOISE ENGINEERING C (L, T, P) = 4(3, 1, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Sound level and subjective response to sound; Frequency dependent human response to sound, Sound pressure dependent human response. Decibel scale; Decibel addition, subtraction and averaging. Relationship among sound power, sound intensity and sound pressure level. Sound spectra. Octave band analysis. Loudness. Noise: Effects, Ratings and Regulations; Non-auditory effects of noise on people, Auditory Effects of noise, Noise standards and limits in India. Major sources of the noise; Industrial noise sources. Industrial noise control-strategies; Noise control at the source, Noise control along the path, Acoustic barriers, Noise control at the receiver. | 7 |
| **II** | Scope of vibration, important terminology and classification, Degrees of freedom, Harmonic motion; vectorial representation, complex number representation, addition. Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton’s second law, D’ Alembert’s principle and Principle of conservation of energy. Compound pendulum and centre of percussion. Damped vibrations of single degree of freedom systems. Viscous damping; under damped, critically damped and over damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped and Hysteretic damped systems. | 7 |
| **III** | Forced vibrations of single degree of freedom systems. Forced vibration with constant harmonic excitation. Steady state and transient parts. Frequency response curves and phase angle plot. Forced vibration due to excitation of support. Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating unbalance. Materials used in vibration isolation. | 7 |
| **IV** | System with two degrees of freedom; principle mode of vibration, Mode shapes. Undamped forced vibrations of two degrees of freedom system with harmonic excitation. Vibration Absorber; Undamped dynamic vibration absorber and centrifugal pendulum absorber. Many degrees of freedom systems: exact analysis. | 7 |
| **V** | Many degrees of freedom systems: approximate methods; Rayleigh’s, Dunkerley’s, Stodola’s and Holzer’s methods. Vibrations of continuous systems; Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Mechanical Vibrations; G.K.Grover, Nemi Chand & Bros., Roorkee
2. Vibration Theory & Applications; W.T.Thomson
3. Vibration & Noise for Engineers; K.K.Purja, Dhanpat Rai & Sons, Delhi
4. Theory & Problems of Mechanical Vibrations; W.W.Seto, Schaum's Outline Series, McGraw Hill International Editions
5. Mechanical Vibrations, Den Hartog
6. Vibration Problems in Engineering, Timshenko

**AE 308 VEHICLE DYNAMICS C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Introduction; Vehicle Dynamics Definitions as prescribed by SAE, Newtonian andlagrangian formulations of multibody systems.Handling and stability characteristics: Steering geometry, fundamental equations for truerolling, Ackerman steering gear. Steady state handling neutral steer, under steer and oversteer, steady state response, yaw velocity, lateral acceleration, curvature response,directional stability | 7 |
| **II** | Performance characteristics of road vehicle; Various forces opposing vehicle motion, theirnature and factors affecting these forces. Tractive effort and power available from theengine, equation of motion, maximum tractive effort and weight distribution, stability ofvehicle on slop, road performance curves, acceleration, grad ability, drawbar pull.Transient operation of vehicles: inertia effects, equivalent mass, equivalent moment ofinertia, time taken in synchronization during change of gears, effect of flywheel inertia onacceleration, dynamic of vehicles on banked track, gyroscopic effects , net driving power. | 7 |
| **III** | Braking performance; Braking of vehicles, brakes applied to rear wheels, front wheel andall four wheels, motion on straight and curved path, mass transfer effects, brakingefficiency, stopping distance, reaction time and stopping time, brake locking anti lockdrives, calculation of mean lining pressure and heat generation during brakes. | 7 |
| **IV** | Vehicle ride characteristics: Human response to vibration, vehicle ride models, road surfaceprofile as a random function, frequency response function, evaluation of vehicle verticalvibration to ride comfort criterion. | 7 |
| **V** | Two wheeler dynamics: Stability & handling, vehicle motion ride control, various vehiclemodels, gyroscopic effect, effect of tyre and vehicle parameter on stability and handlingcharacteristic. | 7 |
|  | **Total** | **35** |

**AE 310 AUTO EMISSION AND POLLUTION CONTROL C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Engine emissions and air pollution: Constituents of engine exhaust responsible for airpollution and their effect on human health, plant ecology, ozone layer depletion and globalwarming, Photochemical smog, greenhouse gases. Kyoto protocol and carbon trading.Formation of Pollutants: Combustion generated and other pollutants, general mechanismsand kinetics of formation of carbon-monoxide, unburnt hydrocarbon, oxides of nitrogenand particulate matter due to combustion, effect of air-fuel ratio on emissions, extendedZeldovitch mechanism for formation of NOx, soot and smoke formation. NOx-particulatetrade-off. | 7 |
| **II** | Emissions from Spark ignition engines: Types of emission form spark ignition engines,importance of mixture formation, lean and rich mixture, study of various mechanism offormation of unburnt hydrocarbon, effect of various design and operating variables onformation of CO, UBHC and NOx. Discussion on different technologies for reducingengine out emissions from a spark ignition engine, gasoline port injection and gasolinedirect injection. Evaporative emissions and their control. | 7 |
| **III** | Emissions from Compression Ignition engines: Types of emissions from compressionignition engine, effect of various design and operating variables on formation of NOx,smoke and particulate matter. Discussion of various technologies for reducing engine outemissions from a compression ignition engine such as turbo charging, inter-cooling, fuelinjection pressure, injection timing retard, exhaust gas recirculation (EGR) etc. | 7 |
| **IV** | Exhaust After treatment: Need for exhaust aftertreatment, fundamentals of catalytic converters, three-way catalyst, diesel oxidation catalyst, diesel particulate filter, effect of fuel sulfur on after treatment devices. Emission Test Procedures: Various test cycles for emission testing of two-three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles used in India, Europe, Japan and USA. Test procedures for various types of evaporative emissions | 7 |
| **V** | Study of emission standards for two-three wheelers, passenger cars, utility vehicles, lightand heavy duty commercial vehicles used in India, Europe, Japan and USA.Equipment for Emission Measurements: NDIR analyzers, Flame ionization detector,chemiluminescence analyzer, constant volume sampling, measurement of smoke andparticulate matter. | 7 |
|  | **Total** | **35** |

**ME 304 MECHATRONICS C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Introduction about Mechatronics, scope of Mechatronics, application, process control automation and N/c Machines.**Hydraulic And Pneumatic Actuation Systems:** Overview: Pressure Control Valves, Cylinders, Direction Control Valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems. | 7 |
| **II** | **Electrical Actuation Systems:** Switching Devices, Mechanical Switches **–** SPST, SPDT, DPDT, Debouncing keypads; Relays, Solid State Switches, Diodes, Thyristors, Transistors, Solenoid, Types Devices: Solenoid Operated Hydraulic and Pneumatic Vlaves, Electro-Pneumatic equencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Control of DCMotors, Bush less Permanent Magnet DC Motors, AC Motors, Stepper Motors, Stepper Motor Controls, Servo Motors. | 7 |
| **III** | **Sensors and transducers and application:** Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, Strain Gauge Element, LVDT, Optical Encoders, Pneumatic Sensors, Hall Effect Sensors,Tachogenerators, Strain Gauge Load Cell, Thermostats, Photo Darlington. Interfacing Sensors in Mechantronic System as – Temperature Switch Circuit, Float Systems |  |
| **IV** | **Interfacing controllers:** Interfacing, Buffers, Darlington Pair, I/O Ports, Interface Requirements, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface, Adapters.**Data Acquisition and Control System -** Introduction, Quantitizing theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, transfer function, transient response & frequency response & frequency response, stability criteria. | 7 |
| **V** | **Design of Mechatronic systems -** Introduction, Automatic front and book and cutting in steel rolling mill, lift control system, CNC lathe, temperature control of a heat treatment furnace, EOT crane control panel, Grey grain separators, electrode arm control in electric arc furnace. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Mechatronics Engineering, Tomkinson, D. and Horne, J., McGraw Hill, 1996
2. Mechatronics, Bolton, W., Longman, 1995
3. Mechatronics, HMT Hand Book, 1998
4. Understanding Electro-Mechanical Engineering, Kamm, L.J., IEEE Press, New York, 2000
5. NitaigourPremchandMahalik, Mechatronics, Tata Mcgraw-Hill
6. J.P. Holman, Mechanical Measurements,McGraw-Hill
7. T.K.Kundra, P.N.Rao And N.K.Tewari,Numerical Control and Computer AidManufacturing,Tata McGraw-Hill,

**ME 310 Numerical Methods and Applied Statistics C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Errors and significant digits, Roots of algebraic equations Bisection method, secant method,NewtonRaphson method, Graff’s root- squaring method, Iterated synthetic division with quadratic factors method for finding complex roots, | 7 |
| **II** | Solutions of systems of equations (Gauss elimination, Gauss Jordan, and Partition method for linear system of equations, power method for partition, method for linear system of equations, power method for finding eigen values), Forward, backward , central and Divided differences, Newton’s formula of interpolation for equal and unequal intervals. Lagrange’s interpolationformula, Stirling’s and Bessell’s formula, | 7 |
| **III** | Numerical differentiation, Numerical Integration:- Trapezoidal, Simpson’s rule and Gaussian integration (only formula applications) Differential equations and their solutions. Numerical methods for ordinary differential equations (Picard method, Taylor series method, Euler’s method, RangaKutta Method, Predictor- corrector method, Adams- Bashforth method). | 7 |
| **IV** | Sampling theory: Introduction: Moments, Moment generating functions, Skewness, Kurtosis, Correlation and Regression, Normal sampling distributions; Binomial distribution, Poisson distribution, Normal distribution; Sampling distribution of the means; sampling distribution of the differences of the means; sampling distributions of proportions. | 7 |
| **V** | Tests of Significance; t-distributions, chi square distributions, F-distributions.Regression And Correlation; Linear regression; correlation, multiple correlation partial correlation Confidence Limits; Large samples, small samples, error bands in regression | 7 |

**Reference Books:**

1. **B.V.RAMANA.,** McGraw Hill
2. **B.RAM, PEERSON PUBLICATION**
3. **E.KRIZING, WILLY PUBLICATION**

**HS 302 EMPLOYABILITY SKILLS–IV: TECHNICAL WRITING C(L,T,P) = 3(3,0,0)**

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| **Units** | **Course Contents**  | **Hours** |
| 1 | Writing Process- Intro of various types of writings, Gathering, Writing, Reviewing, Editing, Indexing, Testing | 7 |
| 2 | Review Writing- Internal, Friendly and Anonymous reviews, Quantity review, Quality review, Precis Wring, Paragraph Writing, Report Writing- Science and research reports, business Reports, Business Report, Business overview | 7 |
| 3 | Letter Writing- Letter of Inquiry, Letter of adjustment, Claim Letter and follow of Letter, Letter of acceptance, Letter of refusal  | 7 |
| 4 | Job search correspondence- cover letter, CV and resume | 7 |
| 5 | Writing Mails- User Guides, Reference Guide, Online helps, Website, Technical Proposal Writing. | 7 |
|  | Total | 35 |

**LAB**

**AE 352 AUTO TRANSMISSION LAB C (L, T, P) = 1(0, 0, 2)**

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| 1.Technical Specification of two and four wheeled (Petrol and diesel) vehicle and troubleshooting chart of all the chassis and transmission components.2. Dismantling and assembly of chassis and transmission component by using specialtools measurement and omparison like clutches, gearboxes, propeller shafts,differential gearbox, steering mechanism and braking system, inspection for wearand tear, crack breakdown, servicing and cleaning and necessary adjustments.3. Calculation of gear ratios of respective assemblies.4. Study of torque converter.5. Study of janny hydrostatic drive.6. Study of Ward Leonard control system. |

**AE 354 VEHICLE DYNAMICS LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Study of Vehicle stability test.2. To perform static and dynamic balancing on balancing setup.3. To perform the wheel balancing test.4. Study of various parameter at the time of application of brake ( Braking efficiency & stopping distance , Reaction time and stopping time)5. Study of Antilock braking system.6. Study of different steering system used in automobile.7. Study of ride comfort in Vehicle.lights , Electric Horn , Wind shield wipers system )8. Study of different sensor used in modern automotive system.9. Study of various electronics system ( Electronic fuel injection system, Electronicignition system , Air bag , ABS , Electronic fuel injector cleaner). |

**ME 357 MECHANICAL VIBRATION LAB C (L, T, P) = 1(0, 0, 2)**

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| **LIST OF EXPERIMENTS**1. To verify relation T=2 √L/g for a simple pendulum.
2. To determine radius of gyration of compound pendulum.
3. To determine the radius of gyration of given bar by using bifilar suspension.
4. To determine natural frequency of Spring mass System.
5. Equivalent spring mass system
6. To determine natural frequency of free torsional vibrations of single rotor system(a) Horizontal rotor (b) Vertical rotor.
7. To verify the Dunkerleys rule.
8. Study of free damped torsional vibration to performing the experiment to find out damping co-efficient.
9. To conduct experiment on trifilar suspension

10. Vibration of beams concept of more than one degree of freedom Excrtation using eccentric mass. 11. Critical speed of shafts. 12. Study of vibration measuring instruments. |

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15 VII Semester**

 **AE 401 CAD/CAM C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Introduction: Role of computers in design and manufacturing. Influence of computers inmanufacturing environment. Product cycle in conventional and computerizedmanufacturing environment. Introduction to CAD and CAM. Advantages anddisadvantages of CAD and CAMHardware for CAD: Basic hardware structure, working structure, working principles,usages and types of hardware for CAD. Input/output devices, memory, CPU, hardcopy andstorage devices. | 7 |
| **II** | N C System: Definition, applications, Historical background Role of Computers inManufacturing.Numerical Control in CAM: Definition, Historical Background, basic components of NCsystem, Fundamentals of NC: Procedure, Coordinate system, motion control systems,Advantages of NC systems. Economic of NC. machining centers. | 7 |
| **III** | Part Programming: Numerical control part programming: punched tape, tape coding &format. Manual part programming, Computer aided part pragramming NC partprogramming languages. Automatically programmed, tools programming (APT).Description of compact & NC programming with interactive graphics. | 7 |
| **IV** | Computer Numerical Control: Principle of operation of CNC, Features of CNC,Development in CNC systems, Adaptive Control, Direct Numerical Control (DNC)Standard Communication interfaces, Programmable Logic Controllers (PLCs)Communication networks, Trends\* New Development in NC | 7 |
| **V** | Robot Technology: Introduction, Industrial Robots, Robot physical Configuration, BasicRobot motions, Technical features such as work volume, precision of movement speed ofmovement, weight carrying capacity, type of drive systems, Introduction to RobotLanguages, End Erectors, work cell control and interlocks, Robotic sensors, Robotapplications & economics, Intelligent robots, interfacing of a vision system with a Robot. | 7 |
|  | **Total** | **35** |

**AE 403 AUTOMOTIVE HEATING, VENTILATION AND AIR CONDITIONING (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Air conditioning fundamentals:, fundamentals of refrigeration, basics of vehicle airconditioning system, location of air conditioning component in a car – schematic layout ofa refrigeration system, component like compressor, condenser, fan blower, expansiondevice – expansion valve calibration , evaporator pressure regulator ,low and high pressureswitch. | 7 |
| II | Air conditioning heating system: automotive heaters – manually controlled air conditioner– heater system –automatically control air conditioner – air conditioning protection withheater diagnosis chart. | 7 |
| III | Refrigerants: Introduction ,classification, properties, selection criteria, commonly usedrefrigerants, eco friendly refrigerants, global warming and ozone forming potential ofrefrigerants, containers, handling of refrigerants. | 7 |
| IV | Psychrometry: Introduction, Psychrometric properties, Inside and outside design conditionsof air conditioning system.Air distribution: introduction, factors affecting design of air distribution system, types ofair distribution system, air flow through the dashboard recirculating unit, duct system,ventilation, vacuum reserve | 7 |
| V | Air conditioning maintenance and service : cause of air conditioner failure, troubleshooting of air conditioning system, servicing heater system, removing and replacingcomponents, leak testing, compressor service, charging and discharging, performancetesting. | 7 |
|  | Total | 35 |

**AE359 Safety and comfort of Vehicle C(L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passengercompartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone,safety sandwich construction | 7 |
| II | Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics ofpassenger compartment on impact | 7 |
| III | Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety. | 7 |
| IV | Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions | 7 |
| V | Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system | 7 |
|  | Total | 35 |

**TEXT BOOK**
1. Bosch - “Automotive Handbook” - 5th edition - SAE publication - 2000.

**REFERENCES**
1. J.Powloski - “Vehicle Body Engineering” - Business books limited, London - 1969.
2. Ronald.K.Jurgen - “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., - 1999

 **AE 407 MICROPROCESSOR APPLICATION IN AUTOMOBILE C(L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Architecture: General 8 bit microprocessor and its architecture 8085, Z-80 and MC 6800MPU and its pin function: Architecture-Function of different sections. | 7 |
| II | Instruction Set: instruction format-addressing modes-instruction set of 8085 MPU-TSTATE-Machine cycle and instruction cycles-Timing diagrams-Different machine cycles-Fetch and execute operations-estimation of execution times. | 7 |
| III | Assembly Language Programming: Construct of the language programming-Assemblyformat of 8085-Assembly Directive-Multiple precision addition and subtraction-BCD toBinary and Binary to BCD, Multiplication, Division, Code conversion using look up tables-Stack and subroutines. | 7 |
| IV | Data Transfer Schemes: Interrupt structure-Programmed I/O-Interrupt driven I/O, DMASerialI/O.Types of interfacing devices: Input/Output ports 8212, 8255, 8251, 8279. Octal latches andtristate buffers-A/D and D/A converters-Switches, LED’s ROM and RAM interfacing. | 7 |
| V | Applications: Data acquisitions- Temperature control-Stepper motor control-Automotiveapplications Engine control, Suspension system control, Driver information. | 7 |
|  | Total | 35 |

**AE 409 VEHICLE AERODYNAMICS AND VEHICLE BODYENGINEERING C(L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Introduction: Importance of vehicle design in modern automobile industries. Criteria for vehicle body design, Types of frame , construction details, loading points, testing of frames in bending and torsion. Different types of metal joining process used in vehicle body construction. | 7 |
| II | Car Body Details: Types : Saloon , Convertibles, Limousine, Sedan , Hatchback , Racing and sports car. Car visibility- driver's visibility, regulation, visibility test, method of improving visibility and space in cars , Safety in design of car , Car body construction. Bus Body Details : Types: Mini bus, single Decker bus, Double Decker bus, articulated bus , Bus body layout , floor height, engine location, entrance and exit , seat layout , seat dimension. Construction details- frame construction , double skin construction, types of metal section used , conventional and integral type construction. Commercial vehicle Details: Types of body : Flat platform , drop side , fixed side , tipper body , tanker body , light commercial vehicle body types – dimension of driver seat in relation to control- Driver cabin design. | 7 |
| III | Vehicle aerodynamics: Introduction , Aerodynamics forces , Drag, Drag reduction, stability and cross winds various body optimization technique for minimum drag, Wind tunnel testing, Scale model testing, | 7 |
| IV | Body Load: symmetric & asymmetrical vertical loads in car. different load case in vehicle- Bending case , Torsion case, Combined bending and torsion , lateral loading Idealized structure – Structural surface –shear panel method. Body material trim and mechanism: Steel sheet , timber , plastic , GRP, FRP , Properties of materials- corrosion – anticorrosion method. Selection of paints and various processes. Body trimming process- dent beating tools, riveting method, welding method. Body mechanism- door lock mechanism, window glass winding mechanism. | 7 |
| V | Safety in vehicle design: Basics of impacts protection, design for crashworthiness, front impact and side impact analysis, bumper system , energy absorbent forms. Indian Motor acts and its application- The motors vehicle acts 1988, Driving license, Registration of vehicles, Rules of the road, Motor Insurance. | 7 |
|  | Total | 35 |

**ME 411 FINITE ELEMENT ANALYSIS C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Stress strain and deformation relations, plane - stress, planes strain, Principles of minimum PotentialEnergy, principle of virtual work. | 7 |
| **II** | Stiffness method for steady state problems of discrete systems (Bar, trusses, one dimensional heat transfer system) Element stiffness matrix, Assembly of elements, global stiffness matrix and its properties, Node numbering, Displacement and force Boundary conditions, Transformations matrix, Gauss elimination method | 7 |
| **III** | Displacement - Based FEM for solid mechanics;Derivation of finite element equilibrium equations, Langrangian elements (I-D & 2-D elements); CST, rectangle, aspect ratio shape functions, lumping of loads, computability and convergence requirements. Stress calculations Isopohmetric Derivation of Stiffness matrices, bar and plane bilinear elements, Seredipity elements, natural coordinates, numerical integration, Co-continuity p and h refinement | 7 |
| **IV** | Variational Method: Variational Approach for known functional of field problems.Weighted Reidual Methods: Point collection, subdomain collocation, methods of least square, Galerkin. Application of these methods to one dimensional boundary value problems; Structures, fluid mechanics and heat transfer.  | 7 |
| **V** | Finite Elements in Dynamics and Vibrations: Introduction, Dynamic Equations, Mass and Damping Matrics, Mass Matrics, Consistent and Diagonal, Damping, Natural frequencies and Mode Shapes. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Introduction to Finite Elements in Engineering, Tirupathi R. Chandrapatla and Ashok D. Belagundu, Prentice Hall of India. Ltd.
2. Comcept and Applications of Finite Element Analysis, Robert D. Cook. David S. Malkus. Michaiel E. Palesha, John Wiley & Sons.
3. Finite Element Procedures, Klaus Jurgan Bathe, Prentice Hall of India, New Delhi

 **HS 401 TECHNICAL APTITUDE C(LTP)=3(3,0,0)**

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| **Units** | **Course Contents**  | **Hours** |
| 1 | PPL (Principal of Programming Language, C, C++, Java, Asp.net, DSA | 7 |
| 2 | DBMS, RDBMS | 7 |

**BM 449 ENTREPRENEURSHIPDEVELOPMENT C (L, T, P) =3 (3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** |  Need scope and characteristics nature of entrepreneurship ventures in India economic and industrial heritage and entrepreneurship development; current economic and industrial environment with special reference to enterpreneurial ventures and economic growth. Understanding Human Behaviour time management, group dynamics, conflict and stress management | 7 |
| **II** | Small, medium and large industrial sectors, Industrial potential and identification of opportunities, demand and resource based industries, service sector, corporate entrepreneurship, entrepreneurship and technocrat entrepreneurship.**SSI:** definition and legal frame planning for small enterprise; major policies, organization of SSI units, reservation of items for SSI units, role of SIDO, NSIC and SSI corporate. | 7 |
| **III** | Marketing and Price distribution Methods of sales promotion state and central government purchase procedures: promotional and advertising methods, marketing research policies & Strategies, price determinate expert policies Financing of small scale industries, tax concession to SSI units. Machinery on Hire Purchases, Controlled & Scarce Raw Materials. | 7 |
| **IV** | **Production Planning:** Elements of production process managing production life cycle, PERT, CPM; managing production support services, product licensing, patenting; certification agencies, ISO 9000, and 14000, CS 8000 series; Testing facilities, Quality Control. | 7 |
| **V** | Project identification, decision making area money, market, machinery and material; Project planning and executing; working capital management sources and uses of funds; ration analysis; break even analysis, cost control; time control; Evaluation and preparation of project report | 7 |
|  | **Total** | 35 |

**Reference Books:**

1. Organization & Management of Small Scale Industries: Desai, J.V. Himalaya, Bombay, 1985
2. Management of Small Scale Industries: 3rd Himalaya, Bombay, 1986
3. The Story of an Entrepreneur: M.Nath, IMT Monographs
4. Small Industry Entrepreneurs Handbook: Mohan, K.K. Bombay Productivity Services International
5. Handbook of Entrepreneurship: Rao&Pareek. New Delhi: Learning System, 1978

**LAB**

**AE 356 AUTOMOTIVE SYSTEM AND POLLUTION LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Chassis and transmission components- sketches, functions, material2. Study of NDIR Gas analyzer and Fill3. Study of Chemi-luminescent NOx analyzer.4. Measurement of HC, CO, CO2, O2 using exaust gas analyzer. Diesel smokemeasurement.5. Testing and servicing of electrical equipments and accessories; battery, generator, alternator, starter motor, ignition systems and spark plug.6. Inspection and testing of vehicle and engines and preparation of test charts. |

 **AE 453 CAD/CAM LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Analysis of simple automotive components by using FEM package.2. Auto lisp programming – writing and execution of at least 3 programs (2D only)3. Using Pro/E or any other standard solid modular getting a hardcopy of 4 different automotive 3D objects.4. a). Study of NC Machine and simulation of cutting/milling operations using CAM package.b) Machining and simulation of at least two jobs using NC Machine /CAM package.5. Clutch Complete design of clutch component, components and assemblies drawing using drafting software.1. Gear Box: Gear train calculation, Layout of gear box , calculation of bearing loads and selection of bearing. Complete assembly drawing using drafting software. |

**AE 455BODY ENGINEERING LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Perform the visibility test on the vehicle.2. Study of different types of tool used in body shop3. Perform the various joining processes welding, riveting) in the body material.4. Assembling and dismantling of various body mechanisms like door lockmechanism, window winding machine mechanism, passenger seat mechanism.5. Perform the dent beating process on the metal sheet.6. Study and perform the various painting process on the car.7. Make the different scale model (Bus body model, TATA 407 model).8. Study of Modern vehicle design.9. Study of vehicle crash analysis. |

**Syllabus for B.Tech Automobile Engineering**

**Session 2014-15VIII Semester**

 **ME 410 COMPUTATIONAL FLUID FLOW & HEAT TRANSFER C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | Review of basic fluid mechanics and the governing (Navier-Stokes) equations.Types of partial differential equations- hyperbolic, parabolic and elliptic.Traditional solution methods- method of characteristics, separation of variables, Greens function method. | 7 |
| **II** | Preliminary computational techniques: Discretisation, converting derivatives to discrete algebraic expressions, spatial derivatives, time derivatives. Approximation of derivatives, Taylor series expansion, general techniques. Accuracy of discretisation process-higher order vs lower order formulae. | 7 |
| **III** | Finite difference method: conceptual implementation, application to transient heat conduction problem.Convergence, consistency and stability of FD equation. | 7 |
| **IV** | Weighted residual methods: General formulation, Introduction to Finite Volume method.Finite Volume method: Equations with first derivatives and second derivatives. FV method applied to Laplace’s equation. | 7 |
| **V** | Finite Element method: Linear interpolation, quadratic interpolation, two dimensional interpolations. Application to heat transfer problems. | 7 |
|  | **Total** | **35** |

**Reference Books:**

Computational Fluid Dynamics: The Basics with [Applications](http://www.indiastudychannel.com/resources/37094-Syllabus-University-Pune-M-E-Chemical-Engg-Semester-I-Computational-Fluid-Dynamics.aspx), John D.Anderson, McGraw Hill, 1995.
2. Computational Flow Moeling for Chemical Reactor Engineering, V. V. Ranade, Process Engineering Science, Volume 5, 2001.
3. Fundamentals of Grid Generation, Patrick Knupp and Stanly Steinberg, CRC Press,1994.
4. Turbulence Modelling for CFD, D.C. Wilcox 1993,

**AE 404 INDUSTRIAL ROBOTICS C(L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Introduction : Automation and robotics, Brief history of robotics , Development in robotics,Economics aspects of robots, Advantage and disadvantage of using robots I industries.Overview of robots – Present and future applications.Production Design for Robotic Assembly: Production design for robotic and automaticassembly, consideration for assembly oriented product design. Robot safety. | 7 |
| II | Classification and structure of robotic system: .Classification, Geometrical configurations,wrist and its motions, End effectors and its type, links and joints. Robot drive system : – Hydraulic, Electric and pneumatic drive system, Resolution, accuracy and repeatability, Advantage and disadvantage of drive system. | 7 |
| III | Control system and components: Basic control system concept and models, Transferfunction and block diagram of spring mass system, Controllers – proportional,proportional and integral, proportional and derivative, PID, transient and response tosecond order system. Robot actuation and Feedback component – position, velocitysensors. | 7 |
| IV | Robot arm kinematics: Introduction, Direct and inverse kinematics, rotation matrix,rotation matrix about an arbitrary axis, Homogeneous transformation, links, joint and theirparameters, D-H representation. Trajectory Planning: Introduction, general consideration on trajectory planning, jointinterpolated trajectory, planning of Cartesian path trajectories | 7 |
| V | Robot programming and languages : introduction, manual teaching, lead through teaching,programming language – AML and VAL, storing and operating, Task programs.Sensors: Internal state sensors, tactile sensor, proximity sensing, range sensing, forcetorque sensor, elements of computer vision, sensing and digitizing function in machinevision- sampling- quantization-encoding-image storage. Image processing and analysis,feature extraction and object recognition. Artificial intelligence | 7 |
|  | Total | 35 |

**AE 406 AUTOMOTIVE MAINTENANCE & MANAGEMENT C(L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Automobile maintenance: Importance of maintenance, scheduled and unscheduledmaintenance. Preparation of check lists, analysis of breakdown, preventive measures, unitreplacement system, maintenance schedule, chassis lubrication schedule, componentretrieval, estimating repair cost, maintenance record, warranty period, servicing. Inspectionforms. Log books. Trip sheets. Other maintenance record forms.Garage Practice: Types of service station/garage, layout of garage. Factors affecting layout,tools &equipments, transport service undertakings, design a layout for different garage. | 7 |
| II | Engine Maintenance: Dismantling of engine components, cleaning methods, visualinspection and dimensional check of various engine components, minor and major tune up,reconditioning and repairing methods of engine components. Assembly procedure, specialtools used for maintenance, repair and overhauling.Cooling systems- Anti corrosion and antifreeze solutions, radiator, and thermostat.Lubrication oil topping up, oil change, oil relief valve; fuel feed systems, FIP adjustmentand testing, injector testing. | 7 |
| III | Chassis and drive line maintenance: mechanical automotive type gear box- mechanicalautomatic types. Final reduction, propeller shaft, front and rear suspension systems, brakesystems-hydraulic, servo, air. Air bleeding, steering system, axles, wheel alignment- tires. | 7 |
| IV | Electric system maintenance: Battery testing method, starter motor, charging system- a DCgenerator, AC alternator, regulator, ignition system- coil ignition, transistor assistedignition, capacitor discharge ignition. Electric horn, wiper motor, flasher, electric fuelpump, gauges. Lighting system- head lights focusing. Wiring harness testing. | 7 |
| V | Body repair: minor body panel beating, tinkering, shouldering, Painting : Introduction of automotive paints , types of paints, corrosion and anticorrosionmethod, rubbing polishing, working of paint booth ,door lock mechanism, window glassactuation mechanism. | 7 |
|  | Total | 35 |

**ME 408 PRODUCT DESIGN AND DEVELOPMENT C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **Importance of new product-Definition-importance-Development Process -** Importance of new product for growth of enterprise. Definition of product and new product. Responsibility for new product development. Demands on product development team. Classification of products from new product development. Point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products. New product development process and organization. Generic product development process for Market Pull Products. Modification of this process for other types of products. | 7 |
| **II** | **Need analysis- Problem Formulation -** Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification. | 7 |
| **III** | **Generation of Alternatives and Concept Selection -** Concept generation- a creative process, Creativity, Road Elects to creative thinking- Fear of criticism and Psychological set. Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process. Concept feasibility and Concept Selection, Establishing Engineering Specification of Products. | 7 |
| **IV** | **Preliminary & detailed design- Design Review -** Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility. Detailed design of subsystems, component design, Preparation of assembly drawings. Review of product design from point of view of Manufacturing, Ergonomics and aesthetics. | 7 |
| **V** | **Management of New Product – development and Launch -** New Product Management’s Challenges – Maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention. Design Team Staffing and Organization. Setting key mile stone, Identification of Risk Areas, Project Execution and Evaluation Product Launch Strategies.Project Planning – Project Task matrix, estimation of time & resources, project scheduling. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Product Design and Manufacturing, Chital AK and Gupta RC,PHI
2. Product Design and Manufacturing, Ulrich KtandEppinger SD McGraw Hill
3. Product Design and Manufacturing, Lind beck JR, Prentice Hall.
4. Engineering Design Method, Cross, Nigel, John Wiley & Sons.
5. Design for Strength & Production; C.Ritz and F. Koenigsbenger.
6. Human Factors in Engineering and Design; Mark S. Sanders, Ernest J. M.Cormick.
7. Engineering Design, G.E.Deiter.

**AE 402 ALTERNATIVE FUELS AND ENGINE TRIBOLOGYC C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| I | Introduction: estimation of petroleum reserves, need for alternative fuels, availability and properties of alternative fuels. Merits and demerits of alternative fuels.Alcohols: properties of alcohol as SI engine fuel, ethanol and methanol, ethanol- gasoline blends,methanol -gasoline blend, combustion characteristics in the fuel engines, performance and emissioncharacteristics. | 7 |
| II | Compressed natural gas, LPG and biogas, availability of CNG properties, modification required touse in engine- performance and emission characteristics of CNG vehicles SI and CI Engines.Use of LPG in SI engine: performance and emission for LPG.Biogas generation, properties, performance and emission characteristics, storage, handling andsafety aspects, | 7 |
| III | Bio-diesel: different sources of vegetable oils use of straight vegetable oils in engine, -Tran etherification,bio-diesel, bio-diesel properties and standards, biodiesel blends. Engine performanceand emission characteristics with use of biodiesel and its blends, worldwide trends in use of biodiesel.Hydrogen : hydrogen as SI engine fuel, properties combustion characteristics, port injection, timedinjection, direct injection of hydrogen in engines, backfire arrest, performance and emissioncharacteristics, production, storage and handling, safety aspects | 7 |
| IV | Engine Tribology of Fundamentals: function of engine lubrication, fundamental of lubrication regimesof lubrication-hydrodynamic, mixed and boundary lubrication, elasto hydrodynamiclubrication, description of engine components working of each of these regimes. | 7 |
| V | Engine Lubrication System: engine lubrication system and their components, bearing lubrication,lubrication of piston, ring and liners, mechanisms of lubricating oil consumption, method of measuring engine oil consume\ptin, positive crank case ventilation.Cylinder liner and its fitment, characterization and measurement of cylinder liner surface finish, oilfilters- full flow and bypass filters, importance of air filter, wet and dry air filtration. Wear ofdifferent engine parts.Lubricating Oils: classification and service rating of lubricating oils, detailed study of differentproperties of lubricating oils, oil additives, oil drain intervals and used oil analysis, oil coolers. | 7 |
|  | Total | 35 |

 **ME 412 OPERATIONS MANAGEMENT C (L, T, P) = 3(3, 0, 0)**

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| **Units** | **Course Contents**  | **Hours** |
| **I** | **Operations Management:** An Overview - Systems concepts in Operations Management, Objectives in Operations Management, Operations management Decisions, Productivity concepts and measurement, Types of Production Systems. Aggregate planning and master scheduling Objectives of Aggregate planning Methods, Master Scheduling, Objectives, Master Scheduling Methods. | 7 |
| **II** | **Forecasting Demand:** Forecasting Objectives and uses, Qualities & Quantities methods of Forecasting, Opinion and Judgmental Methods Time Series Methods, Exponential Smoothing, Regression and Correlation Methods, Time Series Analysis,Application and Control of Forecasts.Capacity Planning: Capacity Strategy, aspects of Capacity Planning, Determination of Capacity Requirement, Types of capacity, Evaluation of Alternative plant size, Traditional Economic Analysis, Cost-Volume Profit Analysis. | 7 |
| **III** | Materials Management: Scope of Materials Management, Purchase system and procedure, purpose of Inventories, Classification of inventory, factors effecting inventory, inventory models, probabilistic models, inventory systems classification, selective inventory control, stores management, standardization codification and variety reduction. Material and Capacity Requirements Planning Overview, MRP and CRP, MRP Underlying concepts, system parameters, MRP Logic, CRP Activities. | 7 |
| **IV** | Scheduling and controlling Production Activities: Introduction, PAC Objectives and Date Requirements. Scheduling Strategy and Guidelines., Scheduling Methodology, Priority Control, Capacity Control | 7 |
| **V** | Just in Time (JIT) in manufacturing planning & control. Major-elements, Characteristics of Just in Time System pre-requisite for JIT manufacturing, Elements of Manufacturing, Eliminating Waste, Enforced, Problem Solving and Continuous Improvements, Benefits of JIT Purchasing, The Kanban System JIT implementation in Industries.Bottleneck scheduling and theory of constraints. Issues in choosing manufacturing technologies and strategies: product life cycle, standardization, simplification, diversification, value analysis. | 7 |
|  | **Total** | **35** |

**Reference Books:**

1. Production and Operations Management, Adam Everett E.& Elbert Ronald J., PHI
2. production & Operation Management; S.N.Charry, TMH
3. Manufacturing planning and control systems; Berry W.L.Whybark D.C. VollmanT.E.galgotia Publication Pvt. Ltd.
4. Operations Management: Theory and Problems Monk J.G. McGraw Hill.

**LAB**

**AE 452 AUTO MAINTENANCE LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Study and practice on service station equipments and their specifications and servicing of vehicles.2. Study of the faults in the electrical systems such as headlights, side or parking lights, trafficator lights, electric horn, starter and charging system, wind screen wiper.3. Simple tinkering and soldering works of body panel, study of door lock and window glass rising mechanisms.4. Adjustment of pedal play in clutch, brake and hand brake lever and steering wheel play; air bleeding from hydraulic brakes and diesel fuel system5. Wheel bearing, tightening and adjustment.6. Removal and fitting of tires and tubes.7. Drawing of general wiring diagram of various vehicles, like mopeds, scooters, motorcycles, cars. |

**AE 454 AUTO RECONDITIONING LAB C (L, T, P) = 1(0, 0, 2)**

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| 1. Study and practice of engine analyzer.2. study and practice of wheel alignment (Mechanical and computerized) and wheel balancing.3. Testing of vehicle on chassis dynamometer and models on wind tunnel.4. Study and practice ona. Connecting rod alignmentb. Cylinder re-boring machinec. Valve re-facing machined. Brake drum skimming machine5. Study and practice ona. Fuel injection pump calibration equipmentb. Nozzle testerc. Nozzle grinding machine6. Study of tyre re-treading and vulcanizing.7. study and practice on body repair- tinkering and painting8. Heat light focusing test and visibility test9. experimental study of microprocessors as applied to automobiles |