**MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION (MSBTE)**

**I – Scheme**
II – Semester Course Curriculum

Course Title**: Elements of Mechanical, Electrical and Electronics Engineering**
**(**Course Code: ..... **)**

| Diploma Programme in which this course is offered | Semester in which offered |
|---|---|
| Fashion and Clothing Technology | Second |

## 1. RATIONALE

Mechanical, electrical and electronics appliances, equipment are the most essential inputs of any garment industry. Various textile/garment machines and other services like air conditioning, ventilation, water supply, lighting, etc. are powered by electrical energy. The diploma engineer must have knowledge of machines, materials, mechanisms, transmission systems, different types of motors, their working, billing of electrical energy and the safety measures while working in garment industry. Along with this, garment machine manufacturers have introduced many electronic devices for various purposes such as: to indicate, to measure and to control various units of garment processes. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts and principles of mechanical, electrical and electronic engineering in various engineering applications to solve broad based problems.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use mechanical, electrical and electronics equipment in fashion and clothing industry safely.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use laws of machines and materials in garment manufacturing plant.
b. Select transmission drives for garment manufacturing machines.
c. Estimate parameters to solve energy bill problems.
d. Use electrical devices, meters and lamps in apparel industry effectively.
e. Identify application of different types of electronic components in the equipment used in garment industries.
f. Use sensors and microprocessor in garment industries effectively.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | T | P | C | ESE | PA | ESE | PA | |
| 3 | - | 2 | 5 | 70 | 30* | 25 | 25 | 150 |

***(*):*** *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20*

*marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

## 5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

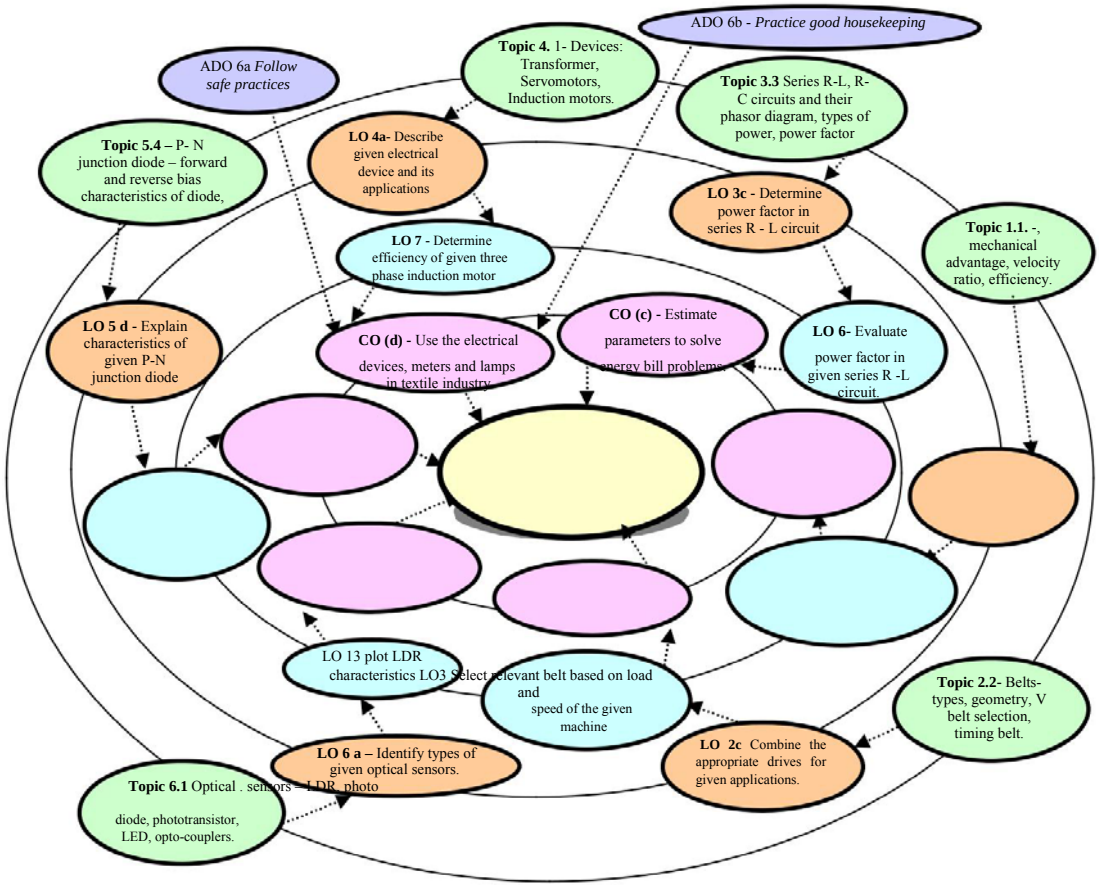


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

| S. No. | Practical Exercises (Learning Outcomes in Psychomotor Domain) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| | **Mechanical** | | |
| 1 | Find velocity ratio, mechanical advantage and efficiency of given worm and worm wheel arrangement. | I | 02* |
| 2 | Determine strain and stress in the given spring. | I | 02 |
| 3 | Select relevant belt for a given machine based on load and speed of the machine. | II | 02* |
| 4 | Select relevant chain for a given machine based on load and speed of the machine. | II | 02 |
| | **Electrical** | | |
| 5 | Find the currents and voltages in a given circuit using Kirchhoff's Laws. | III | 02* |
| 6 | Evaluate the power factor in given series R and L circuit. | III | 02 |
| 7 | Determine the efficiency of given three phase induction motor by direct loading. | IV | 02 |
| 8 | Identify different components of Compact Fluorescent Lamp (CFL) and Light Emitting Diode(LED) lamps. | IV | 02 |
| | **Electronics** | | |
| 9 | Identify different active and passive electronic components. | V | 02 |
| 10 | Evaluate V-I characteristics of forward and reverse bias of diode. | V | 02 |
| 11 | Determine the input and output voltage waveforms of full wave rectifier. | V | 02* |
| 12 | Measure water temperature using RTD (Resistance temperature detector). | VI | 02 |
| 13 | Test the functioning of the LDRs (Light dependent resistors) | VI | 02 |
| 14 | Measure displacement using given LVDT (Linear variable differential transducer). | VI | 02* |
| | **Total** | | **28** |

***Note***

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 20 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 10 |
| 5 | Interpretation of result and Conclusion | 20 |
| 6 | Answer to sample questions | 10 |
| 7 | Submission of report in time | 10 |
| | **Total** | **100** |

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | Exp. S. No. |
|---|---|---|
| 1 | Weights 50gm, 100gm, 200gm, 500gm, 1000gm (three pieces of each) | 1,2 |
| 2 | Worm and worm wheel arrangement | 1 |
| 3 | Various belts and industrial v belt chart | 3 |
| 4 | 1 meter steel rule, half meter steel rule | 1,2 |
| 5 | Actual belts, chains commonly used in textile industries | 3,4 |
| 6 | Dimmerstat - 1 kVA,0-260V AC | 5,6 |
| 7 | Resistance -290 Ω, 100 Ω | 5,6 |
| 8 | Digital multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: $V_{ac}$, $V_{dc}$ ( 1000V max) , $A_{dc}$, $A_{ac}$ (10 amp max) ,(0 - 200Hz) , resistance ( 0 - 100 mΩ) , capacitance and temperature | 5,6,7, 8,9, 10 |
| 9 | Wattmeter 1A (1 no. ), wattmeter 5A ( 2 no.s) | 6,7 |
| 10 | Three phase induction motor 3 HP, three phase, 440V AC | 7 |
| 11 | Ammeter 0-3-10-30 A AC/DC | 5,6,7 |
| 12 | Voltmeter 0-150-300V AC/DC | 5,6,7 |
| 13 | Tachometer for speed measurement 0-3000 rpm | 7 |
| 14 | Different types of LED and CFL lamp | 8 |
| 15 | Resisters, capacitors, inductors, diodes, transistors of different values/ types | 9 |
| 16 | Diode characteristics kit, ammeter 0-5-10-50 milliamp, ammeter, 0-50-500-1000 micro amp, 32 V d. c. power supply, and connecting cords | 10 |
| 17 | Full wave rectifier kit, CRO, probe, connecting cords | 11 |
| 18 | RTD experiment kit, RTD pt-100, resistance 100 Ω at $0^0$C and 138.4 Ω at $100^0$C, temp. range 200 to $850^0$C | 12 |
| 19 | LDR experiment kit, connecting cords, LDR VT935G - voltage rating 100 V, dark resistance – 1 m Ω, resistance @lux – 40.5 k Ω | 13 |
| 20 | LVDT experiment kit, connecting cords. Measuring ranges +/- 1 to 10 mm, linearity +/- 0.3% FSO (Full scale output) | 14 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

| Unit | Major Learning Outcomes (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit –I Machine and Materials** | 1a. Determine efficiency of the given simple machines.<br>1b. Construct graphs of load versus effort for the given simple machine.<br>1c. Identify stresses in various components of the given machines<br>1d. Explain various properties of the given materials with help of stress strain diagram.<br>1e. Explain calculation of factor of safety with relevance to the given situation. | 1.1 Machines - mechanical advantage, velocity ratio, efficiency, Law of machine, reversible machine.<br>1.2 Simple stresses and strains – stress, strain, types of stresses, (simple numerical).<br>1.3 Hooke's law, elastic limit, Modulus of elasticity, modulus of rigidity, ultimate stress, working stress.<br>1.4 Stress strain diagram for ductile material, yield point<br>1.5 Factor of safety |
| **Unit-II Mechanisms and Transmission** | 2a. Describe the geometry of the given belt and chain drives.<br>2b. Explain the given inversion mechanism<br>2c. Select the configuration for the drives for the given application.<br>2d. Distinguish between the given different types of gears | 2.1 Mechanisms- slider crank mechanism, four bar chain mechanism, Inversions of mechanism.<br>2.2 Belts- types, geometry, V belt selection, timing belt. Chains- Types, geometry, roller chain sprocket, Cams- types of cams, types of followers, follower positions<br>2.3 Gears: types and applications. |
| **Unit – III Fundamentals of Electrical Circuits** | 3a. Explain the given electrical quantities and their units.<br>3b. Inter-relate the given electro-magnetic laws.<br>3c. Determine power factor in the given series R - L circuit.<br>3d. Estimate the energy bill for the given A.C. supply circuit. | 3.1 Current, voltage, emf, power, energy and its unit<br>3.2 Kirchhoff's laws: voltage and current, electromagnetic induction, Lenz law, Fleming rules<br>3.3 Series R-L, R-C circuits and their phasor diagram, types of power, power factor and their improvement method by capacitor<br>3.4 Energy bill calculation for single phase and three phase a.c.supply |
| **Unit– IV Electrical Devices, Instruments and Lighting** | 4a. Describe the working of the given electrical device and its application.<br>4b. Identify the given types of meters with justification. | 4.1 Electrical Devices: transformer, servomotors, induction motors and their application<br>4.2 Analog and digital meters for measuring AC/DC electrical |

| Unit | Major Learning Outcomes (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **System** | 4c. Compare types of the given types of lamps in terms of service.<br>4d. Describe the specified method of energy saving in garment industry. | quantities<br>4.3 Lamps, types of lamps, fluorescent tube, UV lamp, D-65, CFL, LED<br>4.4 Methods of energy saving in garment industry. |
| **Unit –V Passive components and Semiconductor Devices** | 5a. Identify the given types of the given active and passive electronic components with justification.<br>5b. Classify the given types of the given materials in terms of conductors, semiconductors and insulators<br>5c. Compare the properties of the given types of semiconductors.<br>5d. Explain characteristics and applications of the given P- N junction diode<br>5e. Describe the working and applications of the given transistor type | 5.1 Active and passive components<br>5.2 Classification of material - conductors, semiconductors and insulators<br>5.3 Semiconductor types – intrinsic, extrinsic, P and N type<br>5.4 P N junction diode – forward and reverse bias characteristics of diode, application – full wave rectifiers<br>5.5 Transistor – construction, types – PNP and NPN, working, Application – amplifier, transistor as switch |
| **Unit-VI Sensors and Microprocessor in Garment Industry.** | 6a. Identify the given types of optical sensor with justification.<br>6b. Identify the given types of displacement sensor with justification.<br>6c. Identify the given types of temperature sensor with justification.<br>6d. Identify the given types of pressure sensor with justification.<br>6e. Identify application of microprocessor in garment manufacturing with justification. | 6.1 Optical sensors – LDR, photo – di diode, phototransistor, LED, opto-couplers<br>6.2 Displacement sensors – LVDT, capacitive sensor<br>6.3 Temperature sensors – RTD, thermistor, thermocouples<br>6.4 Pressure sensors – Bourdon tubes, bellows<br>6.5 Basic concept of microprocessor, microcontroller and applications in garment manufacturing. |

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| | **Mechanical** | | | | | |
| I | Machine and Materials | 08 | 03 | 01 | 07 | 13 |
| II | Mechanisms and Transmission | 08 | 02 | 03 | 07 | 12 |
| | **Electrical** | | | | | |
| I | Fundamentals of Electrical Circuits | 08 | 02 | 04 | 06 | 12 |
| III | Electrical Devices, Instruments ad Lighting System | 08 | 02 | 04 | 06 | 12 |
| | **Electronics** | | | | | |
| V | Passive components and Semiconductor Devices | 08 | 03 | 03 | 06 | 10 |
| VI | Sensors and Microprocessor in Garment Industry | 08 | 02 | 04 | 05 | 11 |
| **Total** | | **48** | **14** | **19** | **37** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note:*** *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Library survey regarding engineering material used in garment manufacturing machineries.
b. Prepare power point presentation or animation for showing different types of transmission drives used.
c. Calculate efficiency and output power of transformer and induction motor.
d. Give seminar on any relevant topic.
e. Library survey regarding machines used in different garment manufacturing industries.
f. Prepare power point presentation or animation for showing different types of motors, transformers and lamps.
g. Prepare power point presentation or animation for sensors, actuators used in garment manufacturing industries.
h. Collect leaflets and specifications of different types of active and passive components used in garment manufacturing industries.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Mechanisms:** Each batch will prepare models for combination of different linkages to form different mechanisms.
b. **Gear trains**: Each batch will prepare model of gear train useful for apparel machines.
c. **Energy bill:** Each batch will visit various garment industry/department and estimate their energy bills.
d. **Electrical transformer**: Each batch will visit, collect and prepare chart to required specifications of transformers used in garment industry.
e. **Electrical servomotors:** Each batch will collect and prepare chart to required specifications and rating of servomotors used in various garment industry.
f. **Electrical induction motors:** Each batch will visit, collect and prepare chart to required specifications and rating of induction motors used in various garment industry.
g. **Electrical lamps and meters:** Each batch will collect and prepare chart to required specifications and rating of different types of lamps and meters used in garment industry.
h. **Resistor color codes:** Each batch will prepare resistor color code charts. Use the chart to calculate values of different resistors. Collect information of variable resistors, rheostats used in laboratory.
i. **Semiconductor devices**: Each batch will prepare list of active/passive components, semiconductor devices used in different textile units spinning, weaving, sizing, dying, and testing. Collect different active semiconductor devices, list their applications and specifications.
j. **Transducers:** Each batch will prepare power point presentation or animation displaying different transducers, actuators used in garment industry.
k. **Sensors:** Each batch will prepare detailed specifications of temperature sensors, pressure sensors, optical sensors, strain gauges used in apparel industry.

l. **Microprocessor:** Each batch will prepare specific information of how microprocessors, microcontrollers used in garment processing and embroidery machines.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Textile mechanics vol I | Slatar, K. | The textile institute, Manchester,1977 ISBN 10: 0900739274 |
| 2 | Machine and Mechanisms | Myszka, David H. | Pearson education, New York, 2011; ISBN: 978-0-13-215780-3 |
| 3 | Strength of Materials Elementary and problems | Timoshenko S. | CBS Publishers,New Delhi 2004, ISBN:9788123910307 |
| 4 | Theory of machines and Mechanisms | Rattan, S.S. | Tata McGraw-Hill Education, New Delhi,2009 ISBN: 9780070144774 |
| 5 | Engineering Mechanics | Bhavikatti,S.S. Rajashekharappa,K.G. | New Age International, New Delhi, 2015, ISBN:9788122437980 |
| 6 | A text-book of electrical engineering. | Rajput R.K. | Laxmi Publications, New Delhi, 2009 ISBN: 9789380386348 |
| 7 | Electric Machinery Fundamentals | Chapman, Stephen J. | McGraw-Hill Education, USA, 2010 ISBN: 97800710705222010 |
| 8 | Electrical Machinery | Bimbhra P.S. | Khanna Publishers, New Delhi, 2014 ISBN: 9788174091734 |
| 9 | Basic Electrical Engineering | Bakshi U.A. Bakshi V.U. | Technical Publications, New Delhi, 2008 ISBN: 9788184314885 |
| 10 | Principles of electronics | Mehta, V.K., Mehta, Rohit | S. Chand New Delhi, 2005 ISBN: 9788121924504 |
| 11 | Basic Electronics (solid state) | Theraja, B. L. | S. Chand New Delhi, 2006 ISBN: 9788121925556 |
| 12 | Electronics and Electrical Measurements and Instrumentation | Sawhaney, A. K. | Dhanpat Rai & Co. New Delhi, 2014 ISBN: 9788177001006 |
| 13 | 8085 microprocessors | Borole Pramod | Lakshmi publishers, New Delhi, 2014 ISBN - 9789382127581 |
| 12 | Electronic controls in Textile Machines | Joshi, Hiren; Joshi, Gauri. | NCUTE training program, New Delhi, 2003 |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://www.nptel.ac.in/courses/112102015/22
b. http://nptel.ac.in/courses/116102012/
c. http://onlinelibrary.wiley.com/subject/code/000080
d. http://www.nptel.ac.in/courses/112102015/22
e. https://en.wikipedia.org/wiki/E-textiles

f. http://eartheasy.com/live_energyeff_lighting.htm
g. http://www.sengpielaudio.com/calculator-ohm.htm
h. http://freevideolectures.com/Course/2335/Basic-Electrical-Technology
i. http://www.electrical4u.com/electric-lamp-types-of-electric-lamp/
j. http://www.electrical4u.com/induction-motor-types-of-induction-motor/
k. https://www.circuitspecialists.com/blog/differences-between-analog-and-digital-panel-meters/
l. http://www.electronicsandyou.com/blog/active-and-passive-electronic-components.html
m. https://www.ethz.ch/flexible-electronics
n. https://learn.sparkfun.com/tutorials/transistors
o. www.ee.buffalo.edu/faculty/paololiu/566/sensors.ppt
p. http://www.zapmeta.com.my/src?q=electronic+sensors&sc=s
q. www.zapmeta.co.in/Electronic+sensors
r. http://www.electronics-tutorials.ws/io/io_3.html
s. http://www.engineersgarage.com/articles/pressure-sensors-types-working
t. www. just-style.com/
u. www.fibre2fashion.com
v. www.ibef.org/industry/textiles.aspx
w. www.makeinindia.com/sector/textiles-and-garments