

Curriculum and Syllabus update

B. TECH.

Electrical and Instrumentation Engineering

Introduction of MOOC's/SWAYAM courses for upcoming semester

(Applicable for 2018-19 batch and onwards)



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School of Engineering and Technology,
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Curriculum

Definitions/ Descriptions

1. Credit Equivalent

	No. of Contact Hours per Week	Equivalent Credits
Lecture+ Tutorial	4/3	3
Practical	2	1

*Mandatory Induction Program

3 weeks duration
<ul style="list-style-type: none">• <i>Physical activity</i>• <i>Creative Arts</i>• <i>Universal Human Values</i>• <i>Literary</i>• <i>Proficiency Modules</i>• <i>Lectures by Eminent People</i>• <i>Visits to local Areas</i>• <i>Familiarization to Dept./Branch & Innovations</i>

***Induction program for students to be offered right at the start of the first year. Appendix –I sheet has attached for details.**

2. Code for Courses:

Code for a course consists of two alphabets followed by three digits and an optional alphabet.

- First three alphabets represent the school name (SET: School of Engineering and Technology).
- Next two alphabets in the code represent the subject area of the course. E.g. (SH: Applied Science and Humanities, EC: Electronics and Communication Engineering, EI: Electrical and Instrumentation Engineering, EE: Electrical Engineering, ME: Mechanical Engineering, CS: Computer Science and Engineering, IT: Information Technology, AECC: Ability Enhancement Compulsory Courses, HS: Humanities and Social Sciences including Management courses, MC: Mandatory Course).
- Then there will be subject code with 4 letters out of which first will tell the nature of subject (C: Core/E: Elective/S: Skill Enhancement/M: Mandatory Course/H: Humanities/A: Applied Science) and next three letters will tell the number according to the semester (for example 801 will tell its 8th semester subject). First digit represents the semester. Next two digits represent the sequence number of course in the list of courses of a semester. Last word in few courses is MOOC, which represents that course may be opted from SWAYAM Portal.

Elective Course:

Elective courses are provided in V, VI, VII and VIII semesters to provide student with flexibility to choose courses of their interest from a list of offered electives. These Electives are the courses offered by the same department or other departments for the students.

MOOC Courses:

“MOOCs” means Massive Open Online Courses (MOOCs) are such online courses which are developed and made available on the SWAYAM platform of Government of India. MOOCs guidelines on online learning issued by the MHRD vide orders dated 11th March 2016 and subsequent addendums issued by the MHRD.

Any candidate can be permitted to opt for only up to 20% of the total courses being offered in a particular program in a semester through the online learning courses provided through SWAYAM platform

Semester-wise list of subjects

Semester I

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	4	3
2	SET/SH/BT/C102	Physics	3	1	-	4	3
	SET/SH/BT/C203	Chemistry					
3	SET/EE/BT/C103 MOOC	Fundamentals of Electrical Engineering*	-	-	-	4	3
	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-		
	SET/ME/BT/C202	Basic Mechanical Engineering					
4	SET/EC/BT/C104	Basic Electronics	3	1	-	4	3
	SET/ME/BT/C204	Engineering Mechanics					
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	4	3
	SET/CS/BT/C205	Computer Programming					
6	AECC106	*Environmental Science	2	-	-	2	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	2	1
	SET/SH/BT/C207	Chemistry Lab					
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	2	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab					
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	2	1
	SET/CS/BT/C208	Computer Programming Lab					
10	SET/ME/BT/S109	***Engineering Graphics	-	-	4	4	2
Total			17	5	10	32	22

*MOOC Course, ** Ability Enhancement Compulsory course.

***Skill Enhancement Course.

Semester IV

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1	SET/EI/BT/C401	Sensors and Transducers	3	1	-	4	3
2	SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	4	3
3	SET/EI/BT/C403	Microprocessors and Microcontrollers	3	1	-	4	3
4	SET/EI/BT/C404	Analytical Instruments	3	1	-	4	3
5	SET/EC/BT/C405	Electromagnetic Field Theory	3	1	-	4	3
6	SET/EI/BT/C406	Circuit Theory	3	1	-	4	3
	SET/EI/BT/C406M OOC	Network Analysis*					
7	SET/EC/BT/C407	Analog Integrated Circuits Lab	-	-	2	2	1
8	SET/EI/BT/C408	Microprocessors and Microcontrollers Lab	-	-	2	2	1
9	SET/EI/BT/C409	Sensors and Transducers Lab	-	-	2	2	1
10	SET/EI/BT/C410	Analytical Instruments Lab	-	-	2	2	1
11	SET/MC/BT/M411	Essence of Indian Traditional Knowledge (*MC)	-	-	-	Self study	Qualifying
Total			18	6	8	32	22

*MOOC Course, ** Mandatory Course.

Semester V

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
	SET/EI/BT/C501	Power Systems	3	1	-	4	

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1	SET/EI/BT/C501 MOOC	Power systems analysis*	-	-	-	-	3
2	SET/EI/BT/C502	Control Systems	3	1	-	4	3
	SET/EI/BT/C502 MOOC	Control Systems*	-	-	-	-	
3	SET/EI/BT/C503	Industrial Instrumentation	3	1	-	4	3
4	SET/EI/BT/C504	Power Electronics	3	1	-	4	3
	SET/EI/BT/C504 MOOC	Power Electronics*	-	-	-	-	
5		PE-01	3	1	-	4	3
6	SET/EI/BT/C506	Power Systems Lab	-	-	2	2	1
7	SET/EI/BT/C507	Control Systems Lab	-	-	2	2	1
8	SET/EI/BT/C508	Industrial Instrumentation Lab	-	-	2	2	1
9	SET/EI/BT/C509	Power Electronics Lab	-	-	2	2	1
10	SET/HS/BT/H510	Foundations of Yoga (**HSMC)	3	1	-	4	3
Total			18	7	8	32	22

*MOOC Course, ** Humanities and Social Sciences including Management courses.

Professional Elective 01 (PE-01)	S. No.	Code	Course Title
	1	SET/EI/BT/E505 (i)	Electrical Drives
	2	SET/EI/BT/E505 (ii)	Line Commutated and Active PWM Rectifiers
	3	SET/EI/BT/E505 (iii)	Electrical Machine Design

Semester VIII

S. No.	Code	Course Title	L	T	P	Contact Hrs./Week	Credits
1		PE-04	3	1	-	4	3
		PE-04MOOC	-	-	-	4	
2		OE-04	3	1	-	4	3
3		OE-05	3	1	-	4	3
4	SET/EI/BT/C804	Major Project	-	-	16	16	8
Total			9	3	16	28	17

Professional Elective 04 (PE-04)	S. No.	Code	Course Title
	1	SET/EI/BT/E801 (i)	Renewable Energy Engineering
		SET/EI/BT/E801 (i)MOOC	Non-conventional Energy Resources*
	2	SET/EI/BT/E801 (ii)	Electrical Distribution System
	3	SET/EI/BT/E801 (iii)	Control Systems Design
4	SET/EI/BT/E801 (iv)	Switchgear and Protection	

*MOOC Course,

Open Elective 04 and 05 (OE-04, OE-05)	S. No.	Code	Course Title
	1	SET/EI/BT/E802 (i)	Data Communication and Networking
		SET/EI/BT/E803 (i)	
	2	SET/EI/BT/E802 (ii)	Virtual Instrumentation
		SET/EI/BT/E803 (ii)	
	3	SET/EI/BT/E802 (iii)	Smart Grid Technology
		SET/EI/BT/E803 (iii)	
	4	SET/EI/BT/E802 (iv)	Mobile Communication and Networks
SET/EI/BT/E803 (iv)			

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Note

- (1) Topic for the Seminar in 6th semesters shall be chosen by students in consultation with faculty. Topic shall not be mentioned in the syllabus anywhere, however, it should be related to Electrical and Instrumentation Engineering.
- (2) Students shall choose 2 professional & 2 open elective subjects in 7th Semester and 1 professional & 2 open elective subjects in 8th semester, each from the given Table. An elective subject shall be offered only when at least 30% of the intake opt for that subject.
- (3) Desirous students opting for an online course would be required to register for the MOOCs for that course/paper through SWAYAM-NPTEL Local Chapter and it will be mandatory for her/him to share necessary information with the college /institute.
- (4) Major Project work shall be carried out during the 7th and 8th semester. Students can undertake Major Project individually or in group of not more than Four students, under the guidance of a faculty or a group of faculty. Students have to present Synopsis of Major Project during the 7th semester. Feasibility of the Project shall be assessed by the project evaluation committee of the department before the end of 7th semester. However, Major Project would be evaluated in the end of 8th semester.

Detailed Syllabi

SEMESTER I

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/SH/BT/C101	Mathematics I	3	1	-	10	20	30	70	100	3
2	SET/SH/BT/C102	Physics	3	1	-	10	20	30	70	100	3
	SET/SH/BT/C203	Chemistry									
3	SET/EE/BT/C103MOOC	Fundamentals of Electrical Engineering*	-	-	-	-	-	-	-	100	3
	SET/EE/BT/C103	Basic Electrical Engineering	3	1	-	10	20	30	70		
	SET/ME/BT/C202	Basic Mechanical Engineering									
4	SET/EC/BT/C104	Basic Electronics	3	1	-	10	20	30	70	100	3
	SET/ME/BT/C204	Engineering Mechanics									
5	SET/IT/BT/C105	Fundamentals of Information Technology	3	1	-	10	20	30	70	100	3
	SET/CS/BT/C205	Computer Programming									
6	AECCI06	**Environmental Science	2	-	-	10	20	30	70	100	2
7	SET/SH/BT/C106	Physics Lab	-	-	2	30	-	30	70	100	1
	SET/SH/BT/C207	Chemistry Lab									
8	SET/EE/BT/C107	Basic Electrical Engineering Lab	-	-	2	30	-	30	70	100	1
	SET/ME/BT/C206	Basic Mechanical Engineering Lab									
9	SET/IT/BT/C108	Information Technology Lab	-	-	2	30	-	30	70	100	1
	SET/CS/BT/C208	Computer Programming Lab									
10	SET/ME/BT/S109	***Engineering Graphics			4	30	-	30	70	100	2
Total											22

*MOOC Course, ** Ability Enhancement Compulsory course.

***Skill Enhancement Course.

L - Lecture hours, T - Tutorial hours, P - Practical hours, T.A - Teacher's Assessment, C.T - Class Test, TOT - Total, ESE - End Semester Examination.

MOOC's/SWAYAM Courses introduced in First Semester:

SET/EE/BT/C103MOOC. FUNDAMENTAL OF ELECTRICAL ENGINEERING		
Module Name	Content	No. of Hrs.
Week 1-3	Basic Concepts and Basic Laws, Methods of Analysis, DC Network Theorems	10

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Week 4-6	Capacitors and Inductors and First Order Circuits, Sinusoidal and Phasors, Sinusoidal Steady-State Analysis	10
Week 7-9	AC Circuit Analysis and Network Theorems, Series and Parallel Resonance and Magnetically Coupled Circuits. Three Phase Circuits and Power Measurements	10
Week 10-12	Single Phase Transformers, Three Phase Induction Machines, DC Machines.	10
Total No. of Hours		40
Textbooks	1. I.J. Nagrath, "Basic Electrical Engineering," Tata Mc. Graw Hill.	
References	1. A. E. Fitzgerald, D.E., Higginbotham and A Grabel, "Basic Electrical Engineering", Mc Graw Hill. 2. Rizzoni, Principles and Applications of Electrical Engineering, TMH. 3. V. Del Toro. "Principles of electrical Engineering, "Prentice hall. 4. W.H. Hayt & J.E. Kemmerly," Engineering circuit Analysis, "Mc Graw Hill. 5. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing.	

SEMESTER IV

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C401	Sensors and Transducers	3	1	-	10	20	30	70	100	3
2	SET/EC/BT/C402	Analog Integrated Circuits	3	1	-	10	20	30	70	100	3
3	SET/EI/BT/C403	Microprocessors and Microcontrollers	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C404	Analytical Instruments	3	1	-	10	20	30	70	100	3
5	SET/EC/BT/C405	Electromagnetic Field Theory	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C406	Circuit Theory	3	1	-	10	20	30	70	100	3
	SET/EI/BT/C406M OOC	Network Analysis*	-	-	-	-	-	-	-		
7	SET/EC/BT/C407	Analog Integrated Circuits Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C408	Microprocessors and Microcontrollers Lab	-	-	2	30	-	30	70	100	1
9	SET/EI/BT/C409	Sensors and Transducers Lab	-	-	2	30	-	30	70	100	1
10	SET/EI/BT/C410	Analytical Instruments Lab	-	-	2	30	-	30	70	100	1
11	SET/MC/BT/M411	Essence of Indian Traditional Knowledge (*MC)	-	-	-	-	-	-	-	100	-
Total											22

*Mandatory Course.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

MOOC's/SWAYAM Courses introduced in Fourth Semester:

SET/EI/BT/C406MOOC. NETWORK ANALYSIS		
Module Name	Content	No. of Hrs.
Week 1-3	Introduction to Network, circuit elements & sources. KVL & KCL, Solution of linear differential equation with different excitation, Deeper look into energy storing elements, inductor and capacitor.	10
Week 4-6	Ideal and practical voltage & current sources. Mesh and nodal analysis of networks. Transforming voltage to current source and vice-versa. Thevenin / Norton's equivalent circuit.	10
Week 7-9	Tellegen Theorem and its implication. Theory of reciprocity. Network function. Two-port network: Z-parameters, Y-parameters, h-parameters & ABCD parameters. Definition of graph & tree of a network. Cut-set matrix.	10
Week 10-12	[A],[B] & [Q] matrices : Relationship among them, Tutorial -1, Tutorial-2	10
Total No. of Hours		40
Textbooks	1. D. Roy Choudhary, Network and Systems, Wiley Eastern,.	
References	1. Van Valkenburg M E, Network Analysis 3rd Edition, Prentice Hall. 2. Van Valkenberg M.E., Introduction to Modern Network Synthesis, John Wiley and Sons. 3. Franklin. F. Kuo, Network Analysis and Synthesis, John Wiley & sons. 4. Hayt, Kimmerly, Engineering Circuit Analysis, McGraw-Hill. 5. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw-Hill. 6. Ryder J.D., Networks, Lines and Fields, Prentice Hall. 7. B. P. Lathi, Linear Systems and Signals, Oxford University Press.	

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8. DeCarlo, R.A., & Lin, "Linear Circuit Analysis", 2 nd Edition, OUP Indian Edition 2003.
9. Mahmood Nahvi, Joseph, A. Edminister, "Theory and Problems of Electric Circuits – Schaum's outline series", McGraw Hill.
10. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach" McGraw Hill Book Company.
11. A.Chakrabarti,"Circuit Theory" Dhanpat Rai & Co.

SEMESTER V

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1	SET/EI/BT/C501	Power Systems	3	1	-	10	20	30	70	100	3
	SET/EI/BT/C501 MOOC	Power Systems Analysis*	-	-	-	-	-	-	-	100	
2	SET/EI/BT/C502	Control Systems	3	1	-	10	20	30	70	100	3
	SET/EI/BT/C502 MOOC	Control Systems*	-	-	-	-	-	-	-	100	
3	SET/EI/BT/C503	Industrial Instrumentation	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C504	Power Electronics	3	1	-	10	20	30	70	100	3
	SET/EI/BT/C504 MOOC	Power Electronics*	-	-	-	-	-	-	-	100	
5		PE-01	3	1	-	10	20	30	70	100	3
6	SET/EI/BT/C506	Power Systems Lab	-	-	2	30	-	30	70	100	1
7	SET/EI/BT/C507	Control Systems Lab	-	-	2	30	-	30	70	100	1
8	SET/EI/BT/C508	Industrial Instrumentation Lab	-	-	2	30	-	30	70	100	1
9	SET/EI/BT/C509	Power Electronics Lab	-	-	2	30	-	30	70	100	1
10	SET/HS/BT/H510	Foundations of Yoga (**HSMC)	3	1	-	10	20	30	70	100	3
Total											22

*MOOC Course, ** Humanities and Social Sciences including Management courses.

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

Professional Elective 01 (PE-01)	S. No.	Code	Course Title
	1	SET/EI/BT/E505 (i)	Electrical Drives
	2	SET/EI/BT/E505 (ii)	Line Commutated and Active PWM Rectifiers
	3	SET/EI/BT/E505 (iii)	Electrical Machine Design

MOOC's/SWAYAM Courses introduced in Fifth Semester:

SET/EI/BT/C501MOOC. POWER SYSTEM ANALYSIS		
Module Name	Content	No. of Hrs.
Week 1-3	Structure Of Power System and Few Other Aspects, Resistance, Inductance, and Capacitance of Transmission Lines, Power System Components and Per Unit System	10
Week 4-6	Characteristics and Performance of Transmission Lines, Load Flow Analysis	10
Week 7-9	Optimal System Operation, Symmetrical Fault.	10
Week 10-12	Symmetrical Components, Unbalanced Fault Analysis, Power System Stability.	10
Total No. of Hours		40
Textbooks	1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.	
References	2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995. 3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999. 4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003. 5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.	

SET/EI/BT/C502MOOC. CONTROL SYSTEMS		
Module Name	Content	No. of Hrs.
Week 1-3	Introduction to Control, Classification of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform. Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros. response to various Inputs, Effect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability.	10
Week 4-6	Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Specification, First	10

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	Order Systems. Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time. Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design.	
Week 7-9	Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors. Root Locus and its Application in Control Design. Frequency Response, Bode Plots, Nyquist Plots.	10
Week 10-12	Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins. Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation. Case Studies.	10
Total No. of Hours		40
Textbooks	1. I. G. Nagrath, M. Gopal, "Control Systems". Wiley, New York, 1983.	
References	1. K. Ogata, "Modern Control Engg". PHI publications. 2. B. C. Kuo, "Automatic Control Systems". Prentice. Hall.	

SET/EI/BT/C504MOOC. POWER ELECTRONICS		
Module Name	Content	No. of Hrs.
Week 1-3	Introduction to Power Electronics, Power devices : Diodes, SCRs, GTO, BJT, MOSFET, IGBT- Characteristics, working, selection and protection, AC-DC converter: half wave & full wave; uncontrolled, semi-controlled & fully controlled; single-phase and three-phase	10
Week 4-6	Assignment No. 2 and 3 on single-phase and three-phase converters and simulations, AC-AC converters: AC voltage controllers and cycloconverters, Non-isolated DC-DC converters: Buck, Boost, Buck-boost & Cuk	10
Week 7-9	Isolated DC-DC converters, DC-AC Inverters: Single-phase and three-phase, modulation techniques, Current Source inverter	10
Week 10-12	Applications of Power Electronics in Generation, Transmission, Distribution & utilization sectors, Assignment No. 6 on Isolated DC-DC converters: Problems and simulation, Assignment No. 7&8 on DC-AC inverters (single-phase and three-phase): problems and simulation	10
Total No. of Hours		40
Textbooks	1. P.S.Bhimra, Power Electronics. Khanna Publication, Delhi. 2. M.H. Rashid, Power Electronics. P.H.I Private Ltd. New Delhi,	
References	1. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics. John Wiley & Sons, Inc, 2003. 2. M.D. singh & K.B. Khanchandani, power electronics. Tata McGraw-Hill Education.	

.SEMESTER VIII

S. No.	Code	Course Title	L	T	P	T.A	C.T	TOT	ESE	SUB. TOTAL	Credits
1		PE-04	3	1	-	10	20	30	70	100	3
2		OE-04	3	1	-	10	20	30	70	100	3
3		OE-05	3	1	-	10	20	30	70	100	3
4	SET/EI/BT/C804	Major Project	-	-	16	-	-	-	-	100	8
Total											17

L – Lecture hours, T – Tutorial hours, P – Practical hours, T.A – Teacher's Assessment, C.T - Class Test, TOT – Total, ESE - End Semester Examination.

Professional Elective 04 (PE-04)	S. No.	Code	Course Title
	1	SET/EI/BT/E801 (i)	Renewable Energy Engineering
		SET/EI/BT/E801 (i)MOOC	Non-Conventional Energy Resources*
	2	SET/EI/BT/E801 (ii)	Electrical Distribution System
	3	SET/EI/BT/E801 (iii)	Control Systems Design
4	SET/EI/BT/E801 (iv)	Switchgear and Protection	

*MOOC Course,

Open Elective 04 and 05 (OE-04, OE-05)	S. No.	Code	Course Title
	1	SET/EI/BT/E802 (i) SET/EI/BT/E803 (i)	Data Communication and Networking

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	2	SET/EI/BT/E802 (ii) SET/EI/BT/E803 (ii)	Virtual Instrumentation
	3	SET/EI/BT/E802 (iii) SET/EI/BT/E803 (iii)	Smart Grid Technology
	4	SET/EI/BT/E802 (iv) SET/EI/BT/E803 (iv)	Mobile Communication and Networks

MOOC's/SWAYAM Courses introduced in Eighth Semester:

SET/EI/BT/E801 (i)MOOC. NON-CONVENTIONAL ENERGY RESOURCES		
Module Name	Content	No. of Hrs.
Week 1-3	Scale of quantities, Impact of current energy usage, Conventional sources of energy Overview of non-conventional energy resources, Consumption by sector Solar energy incident on earth, solar spectrum	10
Week 4-6	Overview of solar energy technologies, Solar Thermal devices Solar Photovoltaic devices, Performance and durability of solar devices Wind energy, technology and geographical aspects	10
Week 7-9	Geothermal and Biomass Battery basics, types Testing, performance of batteries	10
Week 10-12	Fuel cell types, Fuel processing, concept to product. Characterization and durability of fuel cells Flywheels and super capacitors	10
Total No. of Hours		40
Textbooks	1. D. P. Kothari, "Renewable Energy Resources", PHI Publications.	
References	1. G. D. Rai, "Non- conventional sources of energy", Khanna Publishers, Delhi.	

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