

Design of UG Electronics and Telecommunication Engineering Curriculum aligned to NEP 2020

Mahadev S. Patil, Professor & Head, Department of Electronics & Telecommunication Engineering,
Rajarambapu Institute of Technology, Islampur, Sangli, Maharashtra, India

Abstract— The increasing youth population of India requires high-quality educational opportunities to shape their future. It is the urgent need to design education policy which provides the key to scientific advancements, national integration and economic growth to ensure India's continued progress globally. Thus Ministry of Education of Government of India passed National Education Policy (NEP) in 2020 and thus Directorate of Technical Education of Government of Maharashtra decided to design and implement the curriculum in all autonomous Higher Educational Institutes (HEIs) with effect from academic year 2023-24. This paper describes the implementation of Electronics and Telecommunication engineering curriculum structure at the department of Electronics and Telecommunication Engineering of Rajarambapu Institute of Technology, Islampur, Sangli, Maharashtra, India. Author has summarized components of different categories mentioned in Government Resolution of Government of Maharashtra on NEP 2020 as well as AICTE Model curriculum and compared the category wise credits suggested by both. The author further highlighted the courses and credit requirements to get Honors, Double Minor, Honors with Research degrees for gifted students and multiple entry multiple exit for students facing obstacles in their learning path. The designed curriculum has ensured the multidisciplinary and holistic education and is in line with NEP 2020.

Keywords— Curriculum Structure, Education Policy, Holistic Education, Model Curriculum, Multidisciplinary Education

I. INTRODUCTION

THE education is the most important component for developing youth of the country. Education should have life building, man making, character building and assimilation of ideas. The quality education brings scientific advancement, social justice and equality, national integration (Mamidala Jagadesh Kumar, 2020). Higher education contributes to Sustainable Development Goals (SDGs) and development of the nation. The University Grant Commission (UGC) has published quality mandate for Higher Education Institutions to strive to train the students in critical thinking, higher order thinking capabilities, problem solving skill, communication skill, team work, human values and professional ethics (UGC quality mandate, 2021). Some of the

initiatives related to curriculum and outcome based teaching-learning process with active learning technique (Prabavalikar & Patil, 2022; Patil & Kamerikar 2020) to be undertaken by HEIs by incorporating course outcomes aligned with program outcomes in framing curriculum, Jeevan Kaushal, ICT based learning (Patil & Kamerikar, 2023), social and industry connect, less content and more experiential learning (Yenugu, 2022, Dustker, Bandi & Oakes, 2023).

National Education Policy 2020 was approved by the Government of India on 29 July 2020 (GoI NEP 2020) This policy replaces the previous Policy on Education, 1986. NEP 2020 aims to transform India by contributing to an equitable and vibrant knowledge society by imparting high-quality education to all. The policy emphasis on 360 degree holistic development of students by moving the education towards real understanding and to keep away the students from rote learning. NEP 2020 insists upon removal of compartmentalized education and focus on multidisciplinary Education. NEP 2020 develops respect towards the values, Indian Knowledge System and role and responsibilities in a changing world. It instils skills, and multidisciplinary education that brings commitment for sustainable development goal 4 and thereby reflecting a truly global citizen. While the policy is a novel and progressive document, it is very essential to design curriculum for facilitating learning and teaching (Naveen, 2021).

II. AICTE IN ENGINEERING CURRICULUM

All India Council for Technical Education (AICTE) is executing its mandate to design and develop curriculum at par with government policy and industry needs. Currently multiple entry is allowed at second year of under graduate program of Engineering and Technology through lateral entry. Taking a leaf out of NEP, the AICTE has allowed the options of multiple exit after first year, second year and third year of four years Bachelors engineering program and is mentioned in detail in the Approval Process Handbook 2023-24 (AICTE Approval process handbook, 2023-24).

Salient features of AICTE model curriculum (Model_Curriculum/Final_ECE.pdf, 2023) are optimum credits, three weeks' student induction program at the start of

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Corresponding author: Mahadev S. Patil, Department of Electronics & Telecommunication Engineering, Rajarambapu Institute of Technology, Islampur, Maharashtra, India.

Address: Islampur-415 414, Sangli, Maharashtra (e-mail: mahadev.patil@ritindia.edu).

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program, course outcomes with program outcomes mapping for each course, professional core, elective and open elective courses, on job training in the last year to provide exposure to real time industrial environments, online courses through NPTEL/SWAYAM platform, courses on Entrepreneurship, Design Thinking and Universal Human Value and ethics, Sports and Yoga.

The total credits proposed for the four-year B. Tech/B.E. in Electronics and Communication Engineering (ECE) are 160 credits with the definition of credit as 1 credit is given to 1 Hr. Lecture (L) per week, 1 credit for 1 Hr. Tutorial (T) per week, 0.5 credit for 1 Hr. Practical (P) per week and 1 credit for 2 Hours Practical (P) per week. The essence of including Induction program of three-weeks duration for students at the start of the first year is to imbibe universal human values, physical activity, creative arts and ethics. The lectures by eminent people, visits to local areas and visits to various departments are to be organized.

III. NEP IMPLEMENTATION METHODOLOGY

National Education Policy was introduced in 2020, however due to pandemic situation it was not possible to implement it in 2020 and 2021. After pandemic, the activities of implementing NEP geared up to initiate necessary changes in Indian education system and implementation in Autonomous Engineering Colleges and University departments in 2023. Department of Higher & Technical Education, Govt. of Maharashtra has released following GRs a) Interim Report of NEP- Steering Committee headed by Prof Karmalkar, 2023 b) Prof R D Kulkarni Committee Report on Curricular Framework, 2022 c) Chakradeo Committee Report on Multidisciplinary Institutions, 2022 and d) NEP-2022/(67/23) /TE-2, dated: 4 July, 2023. As per last GR, it is mandatory to autonomous institutes to implement curriculum aligned to NEP with effect from academic year 2023-24 and award 4-years Bachelor degree in 2027 (NEP-2022/(67/23) /TE-2, 2023) as per NEP.

The Four-year Bachelor's Multidisciplinary Engineering degree programme allows to opt for the holistic and multidisciplinary education with major and minors as per their choices. The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG programme with multiple entry and multiple exit options are shown in Table I.

With effect from Academic Year 2023-24, the first year of 4-Years Multidisciplinary Bachelor's Degree in Engg./Tech. Program (B.E./ B.Tech. or Equivalent) will be introduced. Thus, the fourth Year of Bachelor's Engg./ Tech. degree (Level 6.0) with various options- Bachelor's Engg./Tech. degree in chosen Major Engg./Tech. discipline with Multidisciplinary Minor (160-176 credits), OR Bachelor's Engg./Tech. Honours degree in chosen Major Engg./Tech. discipline with Multidisciplinary Minor (180-194 credits) OR Bachelor's Engg./Tech. Honours with Research degree in chosen Major Engg./Tech. discipline with Multidisciplinary Minor (180-194 credits) OR Bachelor's Engg./ Tech. degree in chosen Major Engg./Tech. discipline with Double Minor (Multidisciplinary and specialisation minor, 180-194 credits) will be awarded with effect from Academic Year 2026-27.

Under Bachelor's Engg./Tech. Honours with Research degree in chosen Major Engg./Tech. discipline with Multidisciplinary Minor (180-194 credits), the students will work on a research project or dissertation for 18 credits in the fourth year in the respective Major Engg./Tech. discipline. These 18 Credits will be over and above the min.160-max.176 credits prescribed for four Year Multidisciplinary Bachelor's degree in Engg./ Tech. program.

The Bachelor's Engg./Tech. Honours degree in chosen Major Engg./ Tech. discipline with Multidisciplinary Minor (180-194 credits) enables students to take up five-six additional courses in the same Engg./Tech. discipline of 18 to 20 credits distributed over semesters III to VIII.

Under Bachelor's Engg./Tech. degree in chosen Major Engg./ Tech. discipline with Double Minor (Multidisciplinary and specialisation Minor, 180-194 credits), students would take up five-six additional courses of 18 to 20 credits in another Engg./ Tech. discipline/ emerging areas specialization distributed over semesters III to VIII. students who want to build their capacity in a particular area of interest and increase their chance of employability can opt for this.

Eligibility for admission to the UG Bachelor's degree with Double Minor/ Honours /Research: Minimum CGPA/CPI of 7.5 or minimum 75% after second semester for UG Bachelor's Degree with Double Minor/ Honours and minimum CGPA/CPI of 7.5 or minimum 75% after sixth semester for UG Bachelor's degree with research.

TABLE: I
CREDIT FRAMEWORK

Levels	Qualification Title	Credit Requirements		Semester	Year
		Min.	Max.		
4.5	One Year UG Certificate in Engg./ Tech.	40	44	2	1
5.0	Two Years UG Diploma in Engg/Tech.	80	88	4	2
5.5	Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.)	120	132	6	3
6.0	4-Years Bachelor's degree (B.E./ B. Tech.) in Engg/ Tech. with Multidisciplinary Minor	160	176	8	4
6.0	4-Years Bachelor's degree (B.E./ B. Tech.) in Eng./ Tech.- Honors and Multidisciplinary Minor	180	194	8	4

6.0	4-Years Bachelor's degree (B.E./ B. Tech) in Engg/ Tech.- Honors with Research and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B. Tech.) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors)	180	194	8	4

IV. PROPOSED CURRICULUM ALIGNED TO NEP

The curriculum structure is designed by taking inputs from AICTE Model curriculum, NEP 2020 guidelines of Government of Maharashtra, inputs from Department Advisory Board, inputs from industry experts and Board of Studies. Table II depicts category and courses included in the four years' bachelor's degree programme in Electronics and Telecommunication Engineering with multidisciplinary minor. All the components of curriculum suggested by NEP have been incorporated in the proposed structure. Program core and program elective courses contributes to 72 credits, basic science and engineering science contributes to 18 and 12 credits respectively. Open electives and Humanities and social sciences contributes to 8 and 12 credits respectively. Capstone project is in sixth and seventh semester, summer internship as Community Engagement Project (CEP) at the end of fourth semester whereas internship in industry is made mandatory in last semester. Indian Politics and Economics has been included as Indian Knowledge System course (IKS) while Universal Human Values and Professional Ethics, Sports and Yoga/NSS/Performing Arts included as co-curricular activities. Programming for Problem Solving, English Proficiency Lab and Professional Skill Development courses are included as Ability Enhancement Courses (AEC). Choice has been provided between Marathi, Hindi and Sanskrit for Modern Indian Language. Vocational and Skill Enhancement Courses (VSEC) are included to provide hands on experience. Table III shows the multidisciplinary courses offered to other engineering department students except Electronics and Telecommunication engineering students. These courses included here are designed in such a way that the students of other departments will be able to get knowledge of Electronics and Telecommunication engineering right from fundamentals to applications. Table IV shows double minor courses from emerging specialization Industrial Internet of Things whereas Table V includes courses for Honour degree amounting to total 18 extra credits each spread across from third semester to eighth semester.

TABLE: II
CATEGORY WISE COURSES INCLUDED IN STRUCTURE

Sr. No.	Category	Courses included
1	Basic Science courses	Quantum Physics and Materials, Linear Algebra and Ordinary Differential Equations, Advanced Engineering Chemistry, Calculus and Complex Variables and their corresponding Labs, Biology for Engineers
2	Engineering Science courses	Basic Electrical Engineering, Engineering Graphics, Electrical Engineering Lab, Engineering Science course, Engineering Exploration and Design Project
3	Professional Core courses	Analog circuits, Digital Design, Analog Communication, Network Theory, Applied Mathematics for ECC, Digital Communication, Microcontroller, Linear Integrated Circuits, Technical Aptitude, Signals and Systems, Electromagnetic Waves and Antenna Theory, VLSI Design, Power Electronics, Internet of Things, Computer Communication Network, Embedded System Design and corresponding laboratories
4	Professional Elective courses	Information Theory and Coding, Computer-Aided Design for VLSI, Digital Image Processing, Embedded Processors, Data Structure and Algorithms, Advanced Mobile Communication-5G, RTL Simulation and Synthesis, Speech Processing, RTOS and Embedded C, Computer Architecture and Organization, Wireless Sensor Network, System Verilog, Biomedical Signal Processing, Industry Automation, Soft Computing, Satellite Communication, VLSI Testing, Pattern Recognition, Renewable Energy and Power Electronics, AI and ML
5	Open Elective courses	Sensor Technology, Industrial Internet of Things, Drone Technology, Image Processing, Fuzzy Logic and Neural Network
6	Humanities and Social Sciences including Management courses	Programming for Problem Solving, Indian Politics and Economics, English Proficiency Lab, Professional Skill Development and Foreign Languages, Finance for Engineers, Engineering Management & Economics

7	Experiential Learning Courses	Summer Internship, Capstone project, Industry internship/research internship/Entrepreneurial internship
8	Multidisciplinary Minor	Electronics Devices and Applications, Electronics Communication System, System Analysis using MATLAB, PCB Design and Fabrication, Electronics for Industrial Applications
9	Mandatory Courses	Induction Program, Environmental Sciences, Modern Indian Language
10	Co-curricular activities	Universal Human Values and Professional Ethics, Sports and Yoga/NSS/Performing Arts
11	Vocational and Skill Enhancement Courses	Engineering Practice Lab, Programming with C++, PCB design and fabrication, Scholastic aptitude

TABLE: III
MDM COURSES INCLUDED IN STRUCTURE

Multidisciplinary Minor Courses	Credits	Offered in semester
Electronics Devices and Applications	3	III
Electronics Communication System	3	IV
System Analysis using MATLAB	3	V
PCB Design and Fabrication	2	V
Electronics for Industrial Applications	3	VI

TABLE: IV
DOUBLE MINOR COURSES INCLUDED IN STRUCTURE

Double Minor Courses Specialization (Industrial Internet of Things)	Credits	Offered in semester
Sensors and Actuators	3	III
Wireless Sensor Networks	3	IV
IoT protocols and Security	3	V
Embedded System Design for IoT	3	VI
Android Application Design	3	VII
Cloud Integration using AWS	3	VIII

TABLE: V
HONOR COURSES INCLUDED IN STRUCTURE

Honor Courses	Credits	Offered in semester
Advanced Semiconductor Devices	3	III
Modern Control System	3	IV
Fuzzy Logic	3	V
GUI Design and Interfacing	3	VI
Robotics and Automation	3	VII
Cloud computing with AWS	3	VIII

V. RESULTS AND DISCUSSION

The structure of UG program in Electronics and Telecommunication Engineering has the following categories of courses with the breakup of credits as per NEP 2020 and AICTE model curriculum. However, minor variation is allowed. The institute decided to design and frame structure of total 170 credits. The designed structure is compared and shown in Table VI. Figure 1 shows the comparison and it is evident that the designed structure almost matches with the NEP 2020 guidelines. Table VII shows the structure of exit courses for the student in case want to take exit after first, second or third year.

TABLE: VI
COMPARISON OF COURSES

Sr. No	Category	Credit breakup as per NEP 2020 curriculum guidelines	Credit breakup as per AICTE Model curriculum guidelines	Credit breakup of designed curriculum at institute
1	Basic Science courses (BS)	14-18	23	18
2	Engineering Science courses (ES)	16-12	17	12
3	Professional core courses (PC)	44-56	61	61
4	Professional Elective courses (PE)	20	12	11
5	Open Elective courses (OE)	08	12	06
6	Humanities and Social Sciences including Management courses (HSSM)	14	15	12
7	Experiential Learning	22	20	20

	Courses (Project, seminar and internship in industry or elsewhere) (P & I)			
8	Multidisciplinary Minor (MDM)	14	18-20	14
9	Mandatory Courses (Environmental Sciences, Induction Program, Indian Constitution)		(non-credit)	02
10	Co-curricular activities (CC)	04		04
11	Vocational and Skill Enhancement Courses (VSEC)	08		10
Total credits		160-176 with Minor	160* (plus 18-20 for Minor)	170 with Minor

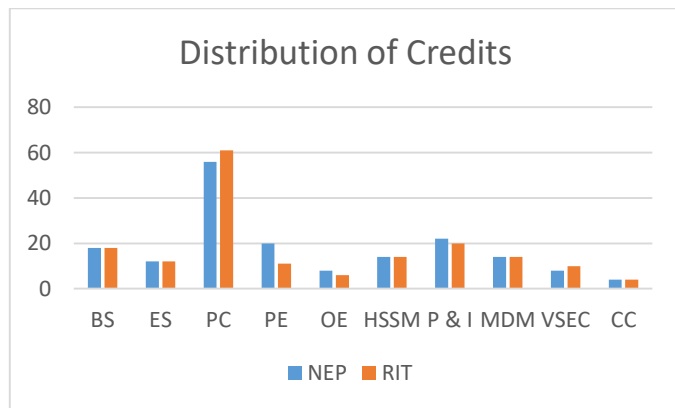


Fig. 1. Comparison of curriculum with NEP guidelines

NEP 2020 has facility to deposit credits earned in Academic Bank of Credits (ABC) which ensures the level of study already completed by student and it does not go in vain and can be used to complete the desired course at a later stage. At the time of exit student should pass any two additional courses (Refer Table VII) or 2-Months internship to qualify for exit to get either certification or diploma or vocational degree so as to earn his/her bread and butter.

TABLE: VII
EXIT COURSES

Year	Level of courses	Exit Courses (Any two courses with total 8 credits)	Exit options
F.Y. B. Tech	ITI	Consumer Electronics	UG Certificate in Engg./Tech.
		Radio Engineering	
		Electronics Servicing and Maintenance	
		Word Processing, Spreadsheet and PowerPoint	
S.Y. B. Tech	Diploma	Data Communication and Networking	UG Diploma in Engg./Tech.
		Fault Finding, Servicing and Maintenance	
		PCB Design and Fabrication	
T.Y. B. Tech	Degree	Mobile Repairing and Maintenance	B. Voc. or B.Sc. (Engg./Tech.)
		Satellite TV Networks	
		Computer Networking / Cyber security	

VI. CONCLUSION

The National Education Policy 2020 aims at providing high-quality education to all. In the context of engineering education, the policy insists upon multidisciplinary, skill development, holistic education and flexible learning pathways. The curriculum structure is implemented by keeping the aims and objectives as well as spirit and intent of the Policy. The B Tech Electronics and Telecommunication Engineering designed curriculum structure aligned to NEP 2020 offers the multidisciplinary courses of 14 credits of their interest, mandatory one semester internship/ On Job Training (OJT), Vocational and Skill Enhancement Courses, Indian Knowledge System course, Community Engagement Project. There are credits for Co-curricular and Extra-Curricular activities besides provision of credits for the Ability Enhancement Courses and Value Education Courses (VEC) in major discipline degree, interdisciplinary or multidisciplinary education through Open Electives. The provision has been made for National Skill Qualification Framework (NSQF) compliant Skill-based Courses and internships for Exits at different levels. The baskets of courses have been offered to gifted students to earn either Honours, Double Minor or Honours with research degree by earning 18-20 credits extra. The designed curriculum is being implemented with effect from 2023-24 and projected outcome of the entire exercise is 360 degree holistic development of the learner.

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