



महाराष्ट्र शासन

Technical Education, Regional Office Pune

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Email ID : ropune@dt Maharashtra.gov.in

No.TEROPUNE/S.S.-03/5G/2023/ 9379

Date : 24 MAR 2023

To,

All Government/Aided/Un-aided Autonomous/ University Affiliated Engg.Colleges
(Specially Autonomus Polytechnics and Engineering Colleges)
Pune Region

**Sub :- Regarding Introduction of 5G courses for UG Programs in Electronics,
Electronics and Telecommunication/ Computer Engineering/
Information Technology**

- Ref. :-** 1. Letter from Secretary, DoT No. D.O.No.11-64/20214-SD dated 3-11-2022
2. Email from DDG(Admin & HR) dated 20-02-2023
3. Directorate of Technical Education Mumbai letter no. 3/DTE/5G/2023
Dated 09-03-2023

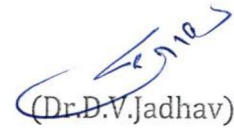
Kindly refer to D.O. letter (Ref.No.1) from Secretary (Telecom), Government of India Dated 03-11-2022 & Email (Ref No.2) received from DDG (Admin & HR), DOT, Mumbai.

With the 5G Spectrum deployments at National Level across the India, there will be from demand for the skilled manpower in almost every district / taluka of the Maharashtra state in the next 3 to 5 years. The ground level roles like "Optical Fiber Technician" to high end job roles like "System Architect - Cloud RAN" etc.

Consequently, there will be many jobs in the areas like Internet of Things (IoT), Artificial Intelligence (AI), M2M communication, augmented reality, Virtual reality. There is an urgent need to address the rising requirements on emerging jobs roles in 5G and 5G enabled services like IoT, AI, M2M etc.

AICTE, New Delhi has published the model Curricula of compulsory core courses like **Mobile Communication and Networks** and the elective courses like **Advanced Mobile Communication (Covered 5G Technology in details)** and **Internet of Things**.

It is hereby instructed to include the AICTE approved courses on 5G Technology in your curriculum for the benefit of all the students and concerned stakeholders


(Dr.D.V.Jadhav)

Joint Director,
Technical Education, Regional office,Pune



महाराष्ट्र शासन



DIRECTORATE OF TECHNICAL EDUCATION

3, Mahapalika Marg, Post Box No. 1967, मुंबई 400 001.
Phone No. 022-68597423/67, Email-desk3@dtmaharashtra.gov.in,
Website: <https://dte.maharashtra.gov.in>



स्वतंत्र्याचा अमृत महोत्सव

No. 3/DTE/5G/2023/ 17

Date: 09/03/2023

To,
Joint Directors Technical Education,
Regional Office,
Amaravati, Aurangabad, Mumbai, Nagpur, Nashik, Pune.

Sub: - Regarding Introduction of 5G courses for UG programs in Electronics, Electronics and Telecommunication / Computer Engineering/ Information Technology

Ref: 1. Letter from Secretary, DoT No. D.O. NO. 11-64/2021-SD dated: 3-11-2022
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Kindly refer to D.O. letter (Ref No.1) from Secretary (Telecom), Government of India Dated 03-11-22 & Email (Ref No. 2) received from DDG (Admin & HR), DOT, Mumbai.

With the 5G spectrum deployments at National Level across the India, there will be a rise in demands for the skilled manpower in almost every district / taluka of the Maharashtra state in the next 3 to 5 years. It is because of nature of the technology and capabilities it offers, there will be a huge need of skilled manpower for ground level roles like "Optical Fiber Technician" to high end job roles like "System Architect - Cloud RAN".

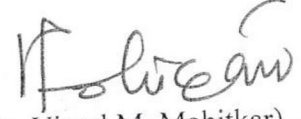
Consequently, there will be spur jobs in the areas like Internet of Things (IoT), Artificial Intelligence (AI), M2M communication, augmented reality, Virtual reality etc. There is an urgent need to address the rising requirements on emerging jobs roles in 5G and 5G enabled services like IoT, AI, M2M etc.

AICTE, New Delhi has published the model curricula of compulsory core course like Mobile communication and Networks and the elective courses like Advanced Mobile communication (Covered 5G Technology in details) and Internet of Things. A copy of the same is attached for your ready reference.

तंत्रशिक्षण विभागीय कार्यालय
पुणे.
20 MAR 2023
आवक क्र. 2404

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ग. तंत्रशिक्षण विभाग
पुणे
11/3

You are hereby instructed to convey all Government/ Aided/ Un-aided Autonomous/University affiliated Engineering colleges (especially Autonomous Polytechnics and Engineering Colleges) regarding inclusion of AICTE approved courses on **5G technology** in the respective curriculum. It is further instructed to send the implementation report regarding the same.



(Dr. Vinod M. Mohitkar)
I/C Director,
Technical Education,
Maharashtra State, Mumbai

Encl: As above

Copy to:

1. Copy for information to Mr Nandlal Suchdev, ITS, DDG (Admin & HR), O/o Sr. DDG, Mumbai LSA, Department of Telecommunications.



Fwd: Meeting regarding Skilling Requirement/initiative in Telecom

1 message

Dr.Vinod Mohitkar <director@dtmaharashtra.gov.in>

Mon, Feb 20, 2023 at 5:59 PM

To: DESK 3 ITCELL <desk3@dtmaharashtra.gov.in>, Umesh Kokate <uvkokate@dtmaharashtra.gov.in>

----- Forwarded message -----

From: **Nandlal Suchdev** <ddga.mb-dgt-dot@gov.in>

Date: Mon, Feb 20, 2023 at 5:45 PM

Subject: Meeting regarding Skilling Requirement/initiative in Telecom

To: <director@dtmaharashtra.gov.in>

Cc: Ajay Kumar Sahu <srddg.mum-dot@gov.in>, Hawa Singh Jakhar <ddgc.mb-dgt-dot@gov.in>, Ajay Kamal <ddgt.mb-dgt-dot@gov.in>, Arbind Kumar Singh <dira.mb-dgt-dot@gov.in>, Mahendra Kumar Jain <dirc.mb-dgt-dot@gov.in>

Sir,

Kindly refer to D.O. Letter dated 03.11.2022 from Secretary (Telecom), Govt. of India, addressed to Chief Secretary, Govt. of Maharashtra regarding works related to Skill Development in 5G areas (Copy enclosed).

Your kind attention is also invited to letter from DDG (Skill Development), DoT regarding Participation in workshop conducted on 6.12.2022 on this subject matter.

You will be happy to know that 5G services have already been launched in Mumbai LSA on 01.10.2022. It is expected that 5G services shall be available throughout the country by the end of this year and more than 500 million customers will be on 5G services. Department of Telecommunications has also organized a workshop in collaboration with IIT Madras, AICTE and Telecom Sector Skill Council for all State Skill Development Corporations & Missions and for Directorates of Tech Education on 5G skill development on 6th December 2022.

There is a need to look closely at creation of the talent pipeline to address these emerging opportunities. Further, there is urgent need to address the rising requirement on emerging job roles in 5G and in 5G enabled services (i.e. 5G, IoT, Machine-2-Machine, AI etc.) through various skill development scheme and programs of Government and by capacity building.

Therefore, in this regard, it is requested to kindly convey your suitable time for a meeting in your office for further deliberations so as to decide the way forward.

Regards

Nandlal Suchdev, ITS

DDG (Admin & HR)

O/o Sr. DDG, Mumbai LSA

Department of Telecommunications

क. राजारामन, भा. प्र. से.
सचिव
K. Rajaraman, IAS
Secretary



सत्यमेव जयते
75
Azadi Ka
Amrit Mahotsav

भारत सरकार
संचार मंत्रालय
दूरसंचार विभाग
Government of India
Ministry of Communications
Department of Telecommunications

D.O No. 11-64/2021-SD
Dated 03 November, 2022

Dear Chief Secretary,

With the 5G spectrum auctions and subsequent deployments, we will be seeing a rise in demand for the skilled manpower in almost every district of India in next 3 years in 5G domain. It is expected that the huge number of trained workforces will be required for preparation of infrastructure for 5G roll out and maintenance over next few years.

2. 5G growth will come from number of use cases in various industrial settings and even at the customer end. 5G, because of nature of technology and capability it offers, will require new range of skills for ground level roles like 'Optical Fibre Technician' to high end job roles like 'System Architect - Cloud RAN'. 5G will also spur jobs in areas like Internet of Things (IoT), Artificial Intelligence (AI), M2M Communication, Augmented Reality, Virtual Reality and other areas. Therefore, there is a need to look closely at creation of the talent pipelines to address these emerging opportunities. More information can be seen at National Qualification Register web portal: <https://www.nqr.gov.in>.

3. Telecom Sector Skill Council (TSSC) has developed emerging skill courses under National Skill Qualification Framework (NSQF) of various levels i.e. starting from Level 3 to Level 6 that relate to students/candidates who are in school, colleges (mainly ITIs and Polytechnics), and higher education institutes. National Council of Vocational Education and Training (NCVET) has already approved various Qualification Packs on 5G oriented roles. Therefore, I request you to kindly consider:

- Immediate
TK
can be done.*
- i. Advising State Skill development missions / State Skill Development Corporations to launch skill development courses on emerging job roles in 5G, IoT, Machine-2-Machine, AI, etc. To facilitate the same, TSSC can organise a 5G skills workshop SSOC/SSDM. The request can be submitted to dirsd-dot@nic.in and TSSC at tssc@tsscindia.com. Shri Alok Bharti, DDG(SD)9868100988 and Shri Arvind Bali CEO, TSSC (9810029050) can facilitate.
- T2*
- ii. Advise State Skill development missions/ State Skill Development Corporations to keep such aspirational job roles in mind while allocating skill training targets under any Government scheme emanating from SDMs, Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDUGKY), National Urban Livelihoods Mission (NULM), etc. SSDM/SSDC may earmark training targets / budgets for 5G skills training.
- iii. Identify the ITIs/ Polytechnics that have basic infrastructure and connectivity and would be right fit to develop skill trainings for such type of futuristic job roles. These centres can be upgraded with incremental investment into technology. TSSC or IIT/NIT concerned can be roped into a hub and spoke arrangement to build capacity of ITIs & Polytechnics. *with*
- Immediate
can be done.*
- iv. Establish 5G use case labs in key Engineering Colleges to enable Engineering College students to get understanding of 5G technologies. Faculty development programs can be undertaken by the Directorate of Tech Education in collaboration with AICTE under the KARMA scheme. (<https://www.aicte-india.org/schemes/KARMA>).

4. I request an early reply.

With Regards,

Yours Sincerely,

(K. Rajaraman)

Encl: List of Qualification Packs with job description for 5G and allied technology.

All Chief Secretaries of States and UTs

List of Qualification Packs (QPS) for 5G and allied Technology approved by NCVET for TSSC

S.	Qualification Code	Qualification Title	NSQF	Job Description
	2022/TEL/TSSC/06	Network Technician - Last Mile Active Network		A Last Mile Active Network Operator is responsible for installing network devices such as network switch, router, and LAN and WAN devices. The individual is also responsible for carrying out preventive and corrective maintenance of the network devices.
	2022/TEL/TSSC/06	AI Devices Installation Operator		An AI Devices Installation Operator is responsible for collecting and analyzing the data from the customers for installation of AI devices, their usage and application in the customer business scenario.
	2022/TEL/TSSC/05	Telecom Rigger - 5G and Legacy Networks		A Telecom Rigger - 5G and Legacy Networks works under supervision and is responsible for assisting in the installation and maintenance of telecom equipment on telecom structures and towers by using rigging and other installation related skills. The individual also assists in upgrading, dismantling and removing telecom equipment and cabling as per the requirements.
	2022/TEL/TSSC/06	IoT Technical Service Operator (4 Elective: Smart City, Agriculture, Telemedicine, Transport)		An IoT Technical Service Operator is responsible for providing technical support concerning the Internet of Things (IoT) systems, including diagnosing and rectifying faults in them. The individual attends to the client queries and provides appropriate solutions following the organisational standards.
	2022/TEL/TSSC/06	Drone Monitoring and Maintenance Associate		The individual in this job role will be responsible for monitoring and maintenance of 5G enabled systems and manage and analyse drone data for 5G connectivity. They are also responsible for repair and maintenance of drone hardware and software systems.
	2022/TEL/TSSC/05	Infrastructure Technician - 5G Networks		An Infrastructure Technician - 5G Networks is responsible for installing 5G network telecommunication equipment on cell tower or a telecom service provider, including the Non-standalone (NSA) and Standalone (SA) infrastructure. The individual also installs and maintains the passive infrastructure equipment installed at 5G network infrastructure sites. The person may also carry out regular repair and maintenance of the 5G network infrastructure.
	2022/TEL/TSSC/05	5G Technician - Active Network Installation		A 5G Technician - Active Network Installation is responsible for carrying out rack-level installation to install 5G network equipment and then carry out the 5G active network installation. The individual also identifies and rectifies faults and malfunctions during the installation process.

2022/TEL/TSSC/06	Cloud Computing – Jr. Analyst	A Cloud Computing – Jr. Analyst, is responsible for carrying out various tests on software applications using cloud computing services to ensure that it meets the user requirements and functions as expected. The individual also coordinates the test preparation activities, finds identified bugs for optimum software/ application performance, and carries out documentation activities.
2022/TEL/TSSC/06	AI & ML – Jr. Telecom Analyst	An AI & ML – Jr. Telecom Data Analyst is responsible for using the relevant Artificial Intelligence (AI) technologies for collecting, processing, and obtaining statistical information from datasets. The individual draws actionable insights and presents the data to the stakeholders for decision-making.
2022/TEL/TSSC/06	IoT Installation Solution Architect	An IoT Installation Solution Architect is responsible for conducting the site survey for layout, planning and designing for installation and deployment of IoT sensors/devices, IoT gateways and access layer connectivity in IoT ecosystem. Suggest and implement the best IoT solution for business model.
2022/TEL/TSSC/05	Project Engineer – 5G Networks	A 5G – Project Engineer is responsible for ensuring that the 5G site is active and running after successful installation and commissioning. Mobile site include 5G antenna, MIMO of New Generation Nodes (gNodeB).
2022/TEL/TSSC/06	Machine Learning (ML) Engineer	A Machine Learning (ML) Engineer develops and runs AI software to automate predictive tasks for recommended searches, virtual assistants, translation apps, etc. The individual designs machine learning systems, generates accurate predictions by applying algorithms, and resolves data set problems.
2022/TEL/TSSC/05	System Architect - 5G Cloud RAN	A System Architect - 5G Cloud RAN is responsible for developing and implementing system architecture for 5G Cloud Radio Access Network (RAN) to enable high-speed wireless telecommunication over a virtualized and centralized or edge cloud network.

Model Curriculum for UG Degree Course in Computer Science and Engineering (Engineering & Technology)

2022



ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

Nelson Mandela Marg, Vasant Kunj, New Delhi 110070

www.aicte-india.org

**Revised Model Curriculum for
UG Degree Course
in
Computer Science and Engineering
(Engineering & Technology)**



ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
NELSON MANDELA MARG, Vasant Kunj, New Delhi - 110070

www.aicte-india.org

Committee for Model Curriculum

S.No	Name	Designation & Organization
1	Dr. Pankaj Jalote	Distinguished Professor and founding Director, IIIT-Delhi. (Chairman)
2	Dr. Dheeraj Sanghi	Professor, Computer Science and Engineering Dept., PEC, Chandigarh
3	Dr. Manoj Singh Gaur	Director, Computer Science and Engineering Dept., IIT Jammu
4	Dr. Nutan Limaye	Professor, Computer Science and Engineering Dept., IIT Bombay
5	Dr. Ramkumar Ramamoorthy	Former Chairman and MD, Cognizant India
6	Mr. Amit Aggarwal	NASSCOM

**This committee was responsible for the design of the CSE curriculum and its courses only. Other committees have designed the common program and non-CSE courses. Complete list of experts who contributed to the design of the CSE curriculum is given at the end.*

PREFACE

Taking cognizance of growing concern about quality of technical education in India, AICTE in its 49th council meeting held on 14.03.2017 approved a package of measures for improving quality of technical education - Revision of Curriculum, Mandatory Internship, and Student Induction Program were amongst the few.

AICTE constituted committee of academia industry experts to prepare model curriculum of UG Course in Computer Science and Engineering. During the development of curriculum, the employability and employment opportunities for graduates, future ready workforce who will be skilled enough to handle the rapid growth in the field of Computer Science and Engineering were kept in mind.

AICTE has introduced mandatory internship in the new curriculum which will equip the students with practical understanding and training about industry practices in a suitable industry or organization. In the course of development of model curriculum, the committee took feedback of industry experts on the draft curriculum and accordingly modified the draft before finalization. This exercise has ensured that essential emphasis on industry requirements and market trends, employability and problem solving approach is given.

After due deliberations, the scheme and syllabus have been formulated. Salient features of this model curriculum are enumerated as under:

- Reduced number of credits.
- Introduction of Student Induction Program.
- Well defined learning objectives & outcomes for each course.
- Inclusion of courses on socially relevant topics.
- Built-in flexibility to the students in terms of professional elective and open elective courses.
- Mandatory internship to equip the students with practical knowledge and provide them exposure to real time industrial environments.
- Virtual Labs.
- Mapping of Courses to its equivalent NPTEL/SWAYAM Course.
- Course on 'Entrepreneurship and Startups' to encourage entrepreneurial mindset.
- Introduction of Design Thinking and Universal Human Value course.

Thanks for the time and efforts of the members of the working group Chaired by Prof. Pankaj Jalote and which included -Dr. Dheeraj Sanghi, Dr. Manoj Singh Gaur, Dr. Nutan Limaye, Dr. Ramkumar Ramamoorthy and other committee members.

Special thanks to Prof. Anil D. Sahasrabudhe, Chairman; Prof. M.P. Poonia, Vice-Chairman; and Prof. Rajive Kumar, Member Secretary, AICTE who all have been instrumental and encouraging throughout the process of development of this model curriculum, and the dedicated efforts of Dr. Naveen Arora, Assistant Director (P&AP);

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Micro Specializations (and Professional Electives)

Besides the core courses, programs normally have professional elective courses, which HEIs decide. It is possible to use the electives to provide a limited specialization in some sub-area of CSE to a B Tech student. We call these as micro-specializations. These also allow multiple pathways to students, as different students can graduate with different specializations (or not). A micro specialization is a set of a few full or half courses, which build upon the core CSE program. The report gives possible structure of a few micro specializations in:

- Software Engineering
- Machine Learning
- Distributed and Cloud Systems
- Human Computer Interaction (HCI)
- Advanced Mobile Communications / 5G Micro Specialization

More specializations definition may be added (e.g. in Security, High Performance Computing, Algorithms). Micro specializations are optional for HEIs – i.e. they can decide to offer them or not, and if they do, which ones they want to. If they decide not to have these, the list of courses mentioned in the micro specializations can be used as a list of suggested professional electives.

Recommendations for Online Credits

A sub-committee was formed to recommend how online credits may be given by HEIs. The recommendations are given as part of the report as an appendix. The recommendations were accepted by the full steering committee.

Recommendations for Multiple Exits

A sub-committee was formed to recommend possible exits for a B Tech CSE student – in line with one of the goals of the NEP. The recommendations are given as part of the report as an appendix. The recommendations were accepted by the full steering committee.

5. Advanced Mobile Communications Micro Specialization

Goal: The aim this specialization is to provide an understanding of the advanced mobile communications technologies, in particular the 5G technology. As India and the world migrate to 5G, with India wishing to take a leading role in 5G technologies, trained manpower in these technologies will be necessary.

Module 1: Evolution from 1G to 5G (11 hours)

Analog voice systems in 1G; digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000: 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates; IMT Advanced: 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+); IMT2020: 5G, enhancements in comparison to IMT Advanced.

Module 2: Basics of 5G (11 hours)

5G potential and applications; Usage scenarios: enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications; Spectrum for 5G, spectrum access/sharing; millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity.

Module 3: 5G Network (14 hours)

New Radio (NR), Standalone and non-standalone mode; non-orthogonal multiple access (NOMA); massive MIMO, beam formation, FAPI: PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP); centralized RAN, open RAN; multi-access edge computing (MEC); software defined networking (SDN), network function virtualization (NFV); network slicing; restful API for service-based interface; private networks.

Module 4: Current state and Challenges ahead (6 hours)

5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements; large cell usage: LMLC; possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul/backhaul solutions: LEOs, HAP/UAV.

Suggested Reference Books

- 4G, LTE-Advanced Pro and The Road to 5G by Erik Dahlman
- 5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio
- Standards Hardcover – 1 June 2019 by Sassan Ahmadi Dr. (Author)

will use and requires knowledge of inherent features of 5G. There will be huge requirement of market ready talent pool in 5G technology.

Considering the need for specialized courses and modules on 5G Technology, National Telecommunication Institute for Policy & Research, Innovation & Training (NTIPRIT)-Department of Telecommunication, after due consultation with academia and industry, sent a proposal to AICTE vide No. 1-3/2020-NTI.TS-SD dated 09.03.2021 to include the following:

- A full Semester course on "Advanced Mobile Communications" for UG
- A 14-hour 5G awareness Program for UG Students;

5G Awareness Programme for UG students (14 hours)

Course Title: Introduction to 5G

Topics to be covered

1. IMT2020 enhancements in comparison to IMT Advanced
2. 5G potential and applications
3. Usage scenarios: eMBB, URLLC, MMTTC
4. Spectrum for 5G and spectrum sharing
5. Millimeter wave communication and small cells
6. New Radio: SA and NSA mode
7. Massive MIMO and beam forming
8. Multi-access edge computing
9. Software defined networks
10. Network slicing
11. Current state of deployment
12. Large cell scenarios: LMLC



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