Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC801	Optical Communication and Networks	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECC801	Optical Communication and Networks	20	20	20	80	03	--	--	100

Course pre-requisite:

FEC102 - Engineering Physics-I
FEC202 - Engineering Physics-II
ECC302 - Electronic Devices & Circuits
ECC405 - Principles of Communication Engineering
ECC501 - Digital Communication
ECC601 - Electromagnetics and Antenna

Course Objectives:

- Introduction to optical fiber network it's need, elements and fundamentals.
- To learn Parameters that limits the repeaterless transmission , its mitigation and Managing techniques.
- To learn high speed optical sources, detectors and Amplifiers.
- Study the multiplexing schemes SDH ,PDH and WDM and its applications for current and NGNs
- To have an insight into optical packet switched, bust switched and advanced networks
- Learn high speed network management techniques and challenges in its counterpart Free Space Optics

Course Outcome:

- Understand optical networks at large by identifying the types of fibers, cables and deployment.
- Design point to point optical fiber communication links using appropriate optical fibers, light sources, couplers, detectors, and multiplexers.
- Design a short haul or long-haul optical network with repeater by incorporating suitable amplifiers.
- Compare SDH, PDH and WDM techniques and implement.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.
- Apply the knowledge acquired to design the next generation fiber and FSO networks for indoor and outdoor applications

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction and Basics of Optical fiber communication**	**07**
	1.1	Historical Development, Electromagnetic Spectrum, Optical Bands and Windows, Need for optical fiber communication, Fiber optic cable types and color codes, Block diagram, advantages and disadvantages of optical fiber cables, loss and bandwidth, applications and deployment.	
	1.2	Basics of Optical Fiber: Review of Ray theory, Wave theory, Light propagation in optical fiber Classification of optical fibers, Propagation modes, MFD in SMF	
	1.3	Fiber material, Fabrication techniques for high quality fiber: MCVD, fiber joints, fiber connectors, splices. Brief introduction to Photonic Crystal Fiber and its types.	
2.0		**Transmission Characteristic of Optical Fiber**	**07**
	2.1	Dispersion in Optical fiber, types of dispersion, Dispersion compensation techniques and dispersion measurements, Time domain and Frequency Domain measurements. Dispersion management, Need for dispersion management and Post compensation techniques.	
	2.2	Transmission losses in the optical fiber, Attenuation, Absorption losses, radiation losses and linear scattering losses, Comparison of optical fibers, Measurement of attenuation: Insertion loss, Return loss, OTDR.	
3.0		**Optical Communication Systems**	**07**
	3.1	Working principle and characteristics of sources Edge emitting LED,, Edge emitting LASER, VCEL, Spectrum, Noise, and Optical amplifiers .	
	3.2	Working principle and characteristics of detectors (PIN, APD),coherent and non-coherent detection, Intensity modulated direct detection, optical receivers, receiver performance: Bit error rate, Q function and Eye diagram	
	3.3	Point to point links system considerations, link power budget, and rise time budget	
4.0		**Optical Network System Components and Optical Networks**	**08**
	4.1	Couplers, isolators , circulators, multiplexers, Optical routers and filters - fiber gratings, Fabry ,switches and wavelength converters ,Add drop multiplexers	
	4.2	SONET and SDH standards, architecture of optical transport networks (OTNs), protection schemes in SONET/SDH, PDH	
	4.3	Operational principle of WDM, WDM network elements and Architectures. Types of WDM Networks, WDM Access Network, WDM Metro Networks, WDM Long Haul Networks Data center networks and Elastic Networks	
5.0		**Packet Switching and Access Networks**	**04**
	5.1	OTDM, multiplexing and de-multiplexing, synchronization and broadcast OTDM networks.	
	5.2	Network architecture overview, optical access networks. FTTH Network	
	5.3	Optical Burst switching Networks	
6.0		**Network Design and Management**	**06**
	6.1	Transmission system model, power penalty, transmitter, receiver, optical amplifiers, crosstalk.	
	6.2	Network management functions, configuration management, performance management, fault management, optical safety, and service interface	
	6.3	Introduction to free space optics and its challenges	
		Total	**39**

Text books:
1. John M. Senior, ―Optical Fiber Communication‖, Prentice Hall of India Publication, Chicago, 3rd Edition, 2013
2. Gerd Keiser, ―Optical Fiber Communication‖, Mc-Graw Hill Publication , Singapore, 4th Edition, 2012
3. T.L.Singhal –Optical Fiber Communication Principles and Applications, Cambridge Press, Edition 2016
4. Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, *Optical Networks: A Practical Perspective*, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
5. Ivan B. Djordjevin,__*Advanced Optical and Wireless Communication Systems*,Springer,Edition 2018.
6. Debasish Datta,*Optical Networks*,Oxword Cambridge University Press,2021
7. Kaushal, H.Jain, V.K. Kar,S, *Free Space Optical Communication* ,Springer,2017

Reference books
1. G Agarwal, ―*Fiber optic communication Systems*‖, John Wiley and Sons, 3rd Edition, New York 2014
2. Rajiv Ramaswami and Kumar N. Sivarajan, ―*Optical Networks: A Practical Perespective*‖, Elsevier Publication Elsevier India Pvt.ltd, 3rd Edition, 2010
3. P.E.Green, ―*Optical Networks*‖, Prentice Hall,1994
4. Biswanath Mukherjee, ―*Optical Communication Networks*‖, McGraw-Hill, 1997.
5. Le Nguyen Binh, ―*Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink*‖, CRC Press, 2010
6. 2. Harry G. Parros, Communication Oriented Networks, Wiley
7. G. Agrwal, *Fiber Optic Communication Systems*, John Wiley and Sons, 3rd Edition, New York, 2014.

Further reading:

https://www.iitg.ac.in/psm/qip2015/material/Subir_Bandyopadhyay_Lecture1.pdf
 https://www.rp-photonics.com/fiber_fabrication.html
www.osa.org

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4.**Total 04 questions** need to be attempted.