

**ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

No. Acd./8092 /UG-15

Dated: July 26, 2019

NOTIFICATION

Subject: Minor restructuring in the programme structures of M.Tech. (SSEM) and M.Tech. (Photonics) (Item No. 79.4)

The Senate in its 79th meeting held on 19.07.2019 considered and approved the proposal of Department of Physics for some minor restructuring in the programme structures of M.Tech. (SSEM) and M.Tech. (Photonics) and syllabus of two courses of M.Tech (Photonics).

The approved structure and syllabi are enclosed herewith as **Appendix- A**.


Asstt. Registrar (Curriculum)

Encl: as above

Copy to(through e-mail):-

1. Chairman Senate & Director
2. Head, Department of Physics
3. All faculty
4. All Head of Departments/Centres
5. Dean of Academic Affairs
6. Associate Deans of Academic Affairs (Admission/Curriculum/Evaluation)
7. Asstt. Registrar (Meetings)
8. Joint Registrar (Academics)
9. Channel I/ Academic webpage of iitr.ac.in

PROGRAM : M.Tech. (Solid State Electronic Materials)
DEPARTMENT : Department of Physics

Teaching Scheme				Contact Hours/Week			Exam Duration (Hrs.)		Relative Weights (%)					
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1st Year				I Semester (Autumn)										
1.	PHN-701	Numerical Analysis and Computational Techniques	PCC	3	2	0	2	3	3	10-25	25	15-25	30-40	0
2.	PHN-703	Fabrication and Characterization Techniques	PCC	3	3	0	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-707	Laboratory Work in Solid State Electronic Materials	PCC	3	0	0	6	0	6	0	50	0	0	50
4.	PHN-709	Semiconductor Device Physics	PCC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
5.	PHN-xxx	Programme Elective –I (Group A)	PEC	4	-	-	-	-	-	-	-	-	-	-
		Sub Total		17										
				II Semester (Spring)										
1.	PHN-704	Advance Characterization Techniques	PCC	4	3	0	3	3	0	10-25	25	15-25	30-40	0
2.	PHN-xxx	Programme Elective-II (Group B)	PEC	-	-	-	-	-	-	-	-	-	-	-
3.	PHN-xxx	Programme Elective-III (Group B)	PEC	-	-	-	-	-	-	-	-	-	-	-
4.	PHN-xxx	Programme Elective-IV (Group B)	PEC	-	-	-	-	-	-	-	-	-	-	-
5.	PHN-700	Seminar	SEM	2	-	-	-	-	-	-	-	-	-	-
		Sub Total		18										
2nd Year				III Semester (Autumn)										
1.	PHN-701A	Dissertation Stage-I	DIS	12	-	-	-	-	-	-	-	-	100	-
2.	PHN-700A	Industrial/Lab Training	ILT	2	-	-	-	-	-	-	-	-	-	-
		Sub Total		14										
				IV Semester (Spring)										
1.	PHN-701B	Dissertation Stage-II	DIS	18	-	-	-	-	-	-	-	-	100	-
		Sub Total		18										
		TOTAL CREDITS		67										

PROGRAM : M.Tech. (Solid State Electronic Materials)
DEPARTMENT : Department of Physics

List of PECs

Teaching Scheme				Contact Hours/Week				Exam Duration (Hrs.)		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Group-A														
1.	PHN-715	Analog Integrated Circuit Design	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
2.	PHN-717	Digital Signal Processing	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-713	Optical Electronics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
Group-B														
1.	PHN-718	Thin Film Technology	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
2.	PHN-708	Materials for Renewable Energy and Storage	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-722	Functional Properties of Materials & Devices	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
4.	PHN-721	Nanoscience and Nanotechnology	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
5.	PHN-723	Engineered materials for Device Application	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
6.	PHN-724	Semiconductor Micro-electronic Technology	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
7.	PHN-725	Nano-electronics and -photonics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
8.	PHN-726	Solar Photovoltaic and Energy Storage	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
9.	PHN-727	Advance Fuel Cell and Battery Technology	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
10.	PHN-728	MEMS and NEMS	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0

11.	PHN-729	Advanced Ceramics and Composites	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
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PROGRAM : M.Tech. (Photonics)
DEPARTMENT : Department of Physics

Teaching Scheme				Contact Hours/Week			Exam Duration (Hrs.)		Relative Weights (%)					
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1st Year				I Semester (Autumn)										
1.	PHN-701	Numerical Analysis and Computational Techniques	PCC	3	2	0	2	3	3	10-25	25	15-25	30-40	0
2.	PHN-703	Fabrication and Characterization Techniques	PCC	3	3	0	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-711	Laboratory Work in Photonics	PCC	3	0	0	6	0	6	0	50	0	0	50
4.	PHN-713	Optical Electronics	PCC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
5.	PHN-xxx	Programme Elective –I (Group A)	PEC	4	-	-	-	-	-	-	-	-	-	-
		Sub Total		17										
				II Semester (Spring)										
1.	PHN-702	Guided-wave Optical Components & Devices	PCC	4	3	0	3	3	0	10-25	25	15-25	30-40	0
2.	PHN-xxx	Programme Elective-II (Group B)	PEC	4	-	-	-	-	-	-	-	-	-	-
3.	PHN-xxx	Programme Elective-III (Group B)	PEC	4	-	-	-	-	-	-	-	-	-	-
4.	PHN-xxx	Programme Elective-IV (Group B)	PEC	4	-	-	-	-	-	-	-	-	-	-
5.	PHN-700	Seminar	SEM	2	0	0	0	0	0	0	0	50	50	0
		Sub Total		20										
2nd Year				III Semester (Autumn)										
1.	PHN-700A	Industrial/Lab Training	ILT	2	0	0	0	0	0	0	0	0	100	0
2.	PHN-701A	Dissertation Stage-I	DIS	12	-	-	-	-	-	-	-	-	100	-
		Sub Total		12										
				IV Semester (Spring)										
1.	PHN-701B	Dissertation Stage-II	DIS	18	-	-	-	-	-	-	-	-	100	-
		Sub Total		18										
		TOTAL CREDITS		67										

PROGRAM : M.Tech. (Photonics)
DEPARTMENT : Department of Physics

List of PECs

Teaching Scheme				Contact Hours/Week				Exam Duration (Hrs.)		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
<u>Group – A</u>														
1.	PHN-709	Semiconductor Device Physics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
2.	PHN-715	Analog Integrated Circuit Design	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-717	Digital Signal Processing	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
<u>Group – B</u>														
1.	PHN-719	Radiation Detection and Measurements	PEC	4	3	0	3	3	0	10-25	25	15-25	30-40	0
2.	PHN-725	Nano-electronics and photonics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
3.	PHN-726	Solar Photovoltaic and Energy Storage	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
4.	PHN-731	Optical Communication System	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
5.	PHN-732	Optical Networks	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
6.	PHN-733	Solid State Lighting	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
7.	PHN-734	Display Technology	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
8.	PHN-735	Photonic Sensors	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
9.	PHN-736	Photonic Analysis and Design	PEC	4	2	0	4	2	3	10-25	25	15-25	30-40	0
10.	PHN-737	Silicon Photonics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0
11.	PHN-738	Quantum Photonics	PEC	4	3	1	0	3	0	20-35	0	20-30	40-50	0

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **DEPARTMENT OF PHYSICS**

1. Subject Code: **PHN-713** Course Title: **Optical Electronics**

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory 3 Practical 0**

4. Relative Weightage: **CWS: 20-35 PRS: 00 MTE: 20-30 ETE: 40- 50 PRE: 00**

5. Credits: **4** 6. Semester: **Autumn** 7. Subject Area: **PEC**

8. Pre-requisite: **Nil**

9. Objective: To introduce the concepts and related phenomena of light matter interaction for applications in optical communication system and photonic devices.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of Maxwell's equations, wave propagation in isotropic and anisotropic dielectric media, double refraction, plane waves in anisotropic media, wave and ray refractive indices, index ellipsoid.	10
2.	Fundamentals of lasers, light amplification, threshold condition, laser rate equations, line broadening, longitudinal modes of a laser, transverse modes of a laser, Q switching and mode locking, basics of semiconductor lasers.	12
3.	Salient features of optical fibers, numerical aperture, light acceptance angle, attenuation, single-mode and multi-mode fibers, step-index and graded-index optical fibers	4
4.	Electro-optic effect in KDP, LiNbO ₃ and LiTaO ₃ , longitudinal and transverse modes, general considerations on modulator design.	5
5.	Acousto-optic effect, Raman-Nath and Bragg diffraction, small and large angle Bragg diffraction, acousto-optic modulator, deflector and spectrum analyzer.	5
6.	Nonlinear optical effects, second harmonic generation, sum and difference frequency generation, optical parametric amplification, self-phase modulation, stimulated Raman scattering, stimulated Brillouin scattering	6
	Total	42

11. Suggested Books:

S.No.	Name of Authors/ Books/Publishers	Year of Publication/ Reprint
1.	Ghatak A. and Thyagarajan K., "Optical Electronics," Cambridge University Press	2016
2.	Saleh B. E. A., and Teich M. C., "Fundamentals of Photonics," Wiley Eastern	2012
3.	Svelto O., "Principles of Lasers", Springer-Verlag	2010
4.	Agrawal G. P., "Optical Fiber Communication System," Wiley Interscience	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **PHYSICS**

1. Subject Code: **PHN-702** Course Title: **Guided Wave Optical Components and Devices**

2. Contact Hours: **L: 3 T: 0 P: 3**

3. Examination Duration (Hrs.): **Theory 3 Practical 0**

4. Relative Weightage: **CWS: 10-25 PRS: 25 MTE: 15-25 ETE: 30- 40 PRE: 00**

5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **PCC**

8. Pre-requisite: **Nil**

9. Objective: To familiarize the students with optical wave guided based technology.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	Integrated optics, electromagnetic analysis of symmetric dielectric planar waveguide, TE and TM modes, power associated with the modes, asymmetric planar waveguides and their modal analysis, single-polarization single-mode waveguides, 2-D waveguides and their analysis, effective index method, perturbation method.	10
2.	Guided wave devices, directional couplers, modulators, Mach-Zhender interferometer, waveguide gratings, arrayed waveguide gratings.	6
3.	Weakly guiding optical fiber, LP modes of a step-index optical fiber, single mode optical fiber and its characteristics, attenuation, pulse dispersion, dispersion shifted fiber, dispersion compensating fiber, fiber fabrication	8
4.	Fused fiber coupler, beam splitter/combiner, WDM coupler, wavelength interleaver, side-polished optical fiber and its applications, polarization controller, isolator, circulator.	6
5.	Optical fiber amplifiers, erbium doped fiber amplifiers (EDFAs), mechanism of optical amplification in EDFA, noise figure, Raman amplifiers, gain spectrum	6
6.	Fiber gratings, fiber Bragg gratings, coupled mode analysis, reflection spectrum, add/drop multiplexer, dispersion compensation, strain and temperature sensing, fabrication techniques, long-period gratings, WDM filter, gain flattening of EDFA, mode converters	6
	Total	42

	<p><u>List of Experiments</u></p> <ol style="list-style-type: none"> 1. Characterization and analysis of wavelength division multiplexers and Demultiplexers. 2. Characterization of fiber Bragg gratings and their sensing properties. 3. Characterization of optical isolator and circulator. 4. Gain and noise study of erbium doped fiber amplifiers. 5. Study of time division multiplexing of digital optical signals. 6. Study of wavelength division multiplexed optical fiber communication link. 7. Study of adding and dropping of optical channels in a fiber link. 8. Qualitative and quantitative study of optical signals using eye diagrams and bit-error rate. 9. Rise and fall time study for bandwidth estimation of optical devices. 10. Study of RZ and NRZ signal generation and detection; and comparative study of the two for non-linearity mitigation in optical fibers. 	14 x 3 hrs
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11. Suggested Books:

S.No.	Name of Authors/ Books/Publishers	Year of Publication/ Reprint
1.	Pal B. P., "Guided Wave Optical Components and Devices	2006
2.	Ghatak A. and Thyagarajan K., "Introduction to Fiber Optics," Cambridge University Press	1998
3.	Agrawal G. P., "Optical Fiber Communication System," Wiley Interscience	2003
4.	Keiser, G., "Optical Fiber Communication," McGraw Hill Education	2014
5.	Shenoy, M. R., Khijwania, S. K., Ghatak, A. K., and Pal, B. P., "Fiber optics through experiments," Viva Books	2014