Sl. No.	LIST OF FIGURES	Page No.
1.1.	Schematic presentation of intercalated and exfoliated PUNCs.	1-22
1.2.	Wide spectrum of PU application.	1-34
2A.1.	(a) FTIR spectra of HPUUs, (b) Deconvoluted FTIR spectra for amide	- 2-12
	I region and (c) Deconvoluted FTIR spectra for -N-H region.	
2A.2.	FTIR spectra of TPUUs.	2-13
2A.3.	(a) <sup>1</sup> H NMR and (b) <sup>13</sup> C NMR spectra of DHA.	2-14
2A.4.	<sup>1</sup> H NMR spectra of <b>(a)</b> HPUU15, <b>(b)</b> LPUU and <b>(c)</b> LPU.	2-14
2A.5.	SEM micrographs of (a) HPUU15, (b) HPUU10, (c) HPUU05 (d	<b>)</b> 2-15
	LPUU and <b>(e)</b> LPU.	
2A.6.	Extent of cross-linking <i>versus</i> time curves for <b>(a)</b> TPUU2, <b>(b)</b> TPUU2	1 2-16
	and (c) HPUU.	
2A.7.	(a) Variation of rate of cross-linking with temperature and (b	<b>)</b> 2-19
	Arrhenius plots of the cross-linking rate constant versus reciprocal of	f
	absolute temperature.	
2A.8.	(a) TG thermograms and (b) $T_g$ of HPUUs, TPUUs, LPUU and LPU.	2-21
2A.9.	(a) Weight loss profiles and (b) Bacterial growth curves of HPUUs	s, 2-23
	TPUUs, LPUU and LPU; (c) SEM images of biodegraded HPUU15 and	d
	LPU after experimental period of six weeks.	
2B.1.	(a) FTIR spectra and (b) UV-visible spectra of WHPUs.	2-34
2B.2.	<sup>1</sup> H NMR spectrum of WHPU15.	2-35
2B.3.	(a) TG thermograms of WHPUs and (b) DSC curves (cooling	) 2-37
	showing $T_g$ of WHPUs.	
2B.4.	Bar diagram of lysis of mammalian RBC membrane by WHPUs	s, 2-38
	hematocrit (positive control) and Twin®20 (negative control).	
2B.5.	(a) Weight loss profiles of WPU0, WHPU05, WHPU10 and WHPU1	5 2-39
	due to bacterial degradation; <b>(b)</b> Growth curves of <i>P. aeruginosa</i> or	n
	WPU0, WHPU05, WHPU10 and WHPU15.	
2B.6.	SEM images of biodegraded (a) WHPU05, (b) WHPU10 and (c	<b>)</b> 2-39
	WHPU15; SEM images of (d) WHPU05, (e) WHPU10 and (f	)
	WHPU15 before biodegradation.	
3.1.	FTIR spectra of WHPU and MWPUs.	3-10

3.2.	Stress-strain profiles of MWPUs.	3-11
3.3.	(a) TG thermograms of MWPUs and (b) DSC curves (cooling)	3-13
	showing $T_g$ of MWPUs.	
3.4.	(a) Weight loss profiles of MWPUs due to bacterial degradation and	3-16
	<b>(b)</b> Bacteria growth curves of <i>P. aeruginosa</i> on MWPUs.	
3.5.	SEM images of biodegraded (a) MWPU10, (b) MWPU20 and (c)	3-16
	MWPU30; (d) Representative SEM image of MWPU30 before	
	biodegradation.	
4.1.	(a) TEM image of CD (inset SAED pattern), (b) Particle size	4-9
	distribution of CD, <b>(c)</b> EDX spectrum of CD, <b>(d)</b> TEM image showing	
	distribution of CD in PNC1.5 (ex situ) and (e) TEM image showing	
	distribution of CD in PNC1.5 (in situ).	
4.2.	HRTEM images of (a) CD, (b) PNC1.5 (ex situ) and (c) PNC1.5 (in	4-10
	situ); Corresponding IFFT images of (d) CD, (e) PNC1.5 (ex situ) and	
	<b>(f)</b> PNC1.5 (in situ).	
4.3.	(a) Raman spectra of (i) CD, (ii) PNC1.5 (ex situ) and (iii) PNC1.5 (in	4-11
	situ); <b>(b)</b> XRD patterns of (i) CD, (ii) PNC1.5 (ex situ) and (iii) PNC1.5	
	(in situ); (c) FTIR spectra of (i) CD, (ii) PNC1.5 (ex situ) and (iii)	
	PNC1.5 (in situ); (d) UV-visible spectra of (i) CD, (ii) PNC1.5 (in situ),	
	(iii) PNC1.5 (ex situ) and (iv) MWPU (inset deconvoluted spectra of	
	PNC1.5 (ex situ) and PNC1.5 (in situ)).	
4.4.	TG thermograms of PNC0.5, PNC1.0 and PNC1.5 (in situ).	4-14
4.5.	(a) % Transmittance of PNCs (in situ), (b) PNC1.5 (in situ) film	4-15
	showing transparency and (c) PNC1.5 (ex situ) film showing	
	transparency.	
4.6.	PL spectra of (a) CD, (b) PNC1.5 (ex situ) and (c) PNC1.5 (in situ); (d)	4-16
	Luminescence of CD under visible, short UV (254 nm) and long UV	
	(365 nm); <b>(e)</b> Demonstration of PNC as a security mark; <b>(f)</b> and <b>(g)</b>	
	Luminescence under visible, short UV (254 nm) and long UV (365	
	nm) of PNCs (ex situ) and PNCs (in situ).	
4.7.	(a) Weight loss profiles of PNCs due to bacterial degradation and (b)	4-17
	Bacteria growth curves of <i>P. aeruginosa</i> on PNCs.	
4.8.	SEM images of (a) biodegraded PNC1.5 (in situ), (b) biodegraded	4-18

	PNC1.5 (ex situ), (c) PNC1.5 (iii situ) belole blodegladation and (d)	
	PNC1.5 (ex situ) before biodegradation.	
4.9.	Alamar Blue cell proliferation assay showing MG63 osteosarcoma	4-19
	cell proliferation on WHPU and PNCs (in situ). Data represented as	
	the average ± standard deviation.	
4.10.	Fluorescent microscopic images showing MG63 cells growing on (a)	4-20
	MWPU, (b) PNC0.5, (c) PNC1.0 and (d) PNC1.5 (in situ) after seven	
	days of culture; Light microscopic images of (f) MWPU, (g) PNC0.5,	
	(h) PNC1.0 and (i) PNC1.5 (in situ) showing mineralized deposits in	
	the form of nodule due to osteogenic differentiation of MG63 cells;	
	Microscopic images (e) and (j) represent PNC1.5 (in situ) film	
	without cell. Scale bar represents 100 μm.	
4.11.	Plot of $(\alpha h \nu)^2$ versus $h \nu$ .	4-22
4.12.	(a) H <sub>2</sub> O <sub>2</sub> production with different materials at different time	4-23
	intervals using PNC4.0 as catalyst, (b) Selectivity curve of $H_2O_2$	
	production with different starting materials (using PNC4.0 as	
	catalyst), (c) Effect of CD loading on $H_2O_2$ production (after 50 h of	
	reaction) and <b>(d)</b> Reusability of the catalyst (PNC4.0).	
<b>5.1.</b>	(a) TEM image of CD, (b) Size distribution of CD, (c) HRTEM image of	5-11
	CD and <b>(d)</b> IFFT of HRTEM of CD.	
5.2.	(a) Raman spectrum and (b) UV-visible spectrum of CD.	5-12
5.3.	RP-HPLC profiles of <b>(a)</b> peptide PS11, <b>(b)</b> PS11 conjugated with CD,	5-13
	(c) peptide CK23, (d) CK23 conjugated with CD, (e) peptide IP3, (f)	
	IP3 conjugated with CD, <b>(g)</b> peptide SR7 and <b>(h)</b> SR7 conjugated with	
	CD.	
<b>5.4.</b>	(a) UV-visible spectra of CDP and (b) Percentage conjugation of	5-14
	peptides with CD.	
5.5.	(a) TEM image of CDP-f-PU matrix (scale bar represents 10 nm) and	5-15
	<b>(b)</b> UV-visible spectra of CDP- <i>f</i> -PU and WHPU.	
5.6	MG63 cell viability assay against different concentrations of CD after	5-16
	12 and 24 h.	
5.7.	(a) MTT cell viability assay and (b) Number of MG63 cells adhered	5-17
	versus time (h) on control WHPII WHPII/Celatin and CDP-f-PII	

Values are presented as mean±SD of three different observations and
significance level was evaluated by comparing with the control using
student t-test statistics: *P<0.05.
Alamar Blue cell proliferation assay of MG63 cells on control, WHPU, $$

- **5.8.** Alamar Blue cell proliferation assay of MG63 cells on control, WHPU, 5-18 WHPU/Gelatin and CDP-*f*-PU. Values are presented as mean±SD of three different observations and significance level was evaluated by comparing with the control using student t-test statistics: \*P<0.05.
- **5.9.** Cell differentiation of MG63 cells on control, WHPU, WHPU/Gelatin 5-18 and CDP-*f*-PU as investigated by ALP assay. Values are presented as mean±SD of three different observations.
- **5.10.** Degradation percentages of WHPU, WHPU/Gelatin and CDP-*f*-PU 5-20 against collagenase. Values are presented as mean±SD of three different observations.
- **5.11.** Representative macroscopic images of post-mortal mouse showing 5-21 the location and texture of **(a)** CDP-*f*-PU (with osteoblasts) and **(b)** CDP-*f*-PU (without osteoblasts) after 14 days of post-implantation.
- 5.12. (a) Morphology of isolated murine osteoblasts cells viewed under 5-22 microscope (magnification 10x); (b) and (c) Alizarin Red S staining of the isolated murine osteoblast cells (Scale bar represents 50 μm); (d) Histogram of RT-PCR data showing the gel electrophoretic bands for PCR products obtained from primer specific amplification of selected genes (drawn from the data obtained by band analysis).
- 5.13. Representative histological sections of the extracted explant viewed 5-23 under the microscope after Hematoxin and Eosin staining: Images (i) to (iv) represent CDP-f-PU with osteoblasts and images (v), (vi) represent CDP-f-PU without osteoblasts. Image (i) is in 10x and (ii), (iii), (iv), (v), (vi) are in 40x magnification. Different zones are identified A=Calcium deposited as mineralized area. B=Osteocytes/Osteoblast embedded in the mineralized area, C=Fat D=High calcium deposited mineralized granules and E=Vascular tissue/endothelial cells.
- **5.14.** Alizarin Red S stained sections of explant from injectate CDP-*f*-PU 5-24 (with osteoblasts): **(a)** at 10x and **(b)** at 40x; Alizarin Red S stained

sections of explant from inje	ectate CDP-f-PU (without osteoblasts): <b>(c</b> )
at 10x and <b>(d)</b> at 40x.	

- 5.15. Whole mount confocal microscopic images of the explant containing CDP-f-PU as injectate (the freshly harvested explant shows a FITC (green) labeled anti-CD31 marking blood vessel lined endothelial cells): (a) 10x image of CDP-f-PU with osteoblasts showing presence of blood vessel near a mineralized granular structure (arrow marked) suggestive of vasculogenesis in the vicinity of calcified zone, (b) Image of CDP-f-PU with osteoblasts at 40x and (c) 10x image of CDP-f-PU without osteoblasts showing vascularization.
- **6.1. (a)** FTIR spectra of CD, HAp and CD@HAp; **(b)** UV-visible spectra of 6-10 CD, HAp and CD@HAp; **(c)** Raman spectra of CD and CD@HAp; **(d)** XRD patterns of egg shell (CaCO<sub>3</sub>), CaO and CD@HAp.
- **6.2. (a)** and **(b)** TEM images of CD@HAp; **(c)** HRTEM image of CD@HAp 6-11 (inset IFFT of HAp and CD phase in the nanohybrid); **(d)** SAED pattern of CD@HAp nanohybrid.
- **6.3. (a)** Representative SEM image and **(b)** EDX spectrum of CD@HAp 6-12 (Ca, P, O and C).
- **6.4. (a)** TEM image of WHPU3/CD@HAp and **(b)** FTIR spectra of MWPU, 6-12 WHPU/HAp and WHPU/CD@HAp.
- **6.5. (a)** TG and corresponding derivative curves of egg shell and **(b)** TG 6-15 and corresponding derivative curves and HAp and CD@HAp.
- **6.6.** TG thermograms of WHPU/CD@HAp nanocomposite. 6-16
- **6.7. (a)** Alamar Blue cell proliferation graph showing MG63 cell 6-17 proliferation with different nanomaterials; **(b)** Alamar Blue cell proliferation graph showing MG63 cell proliferation on different nanocomposite membranes. Data represented as the average±standard deviation. (\* p < 0.05, \*\* p < 0.01).
- 6.8. Fluorescent microscopic images showing MG63 cells growing in 6-18 tissue culture wells after 7 days of culture: (a) control (without nanomaterial), (b) HAp (100 μg mL<sup>-1</sup>), (c) CD (100 μg mL<sup>-1</sup>), (d) CD@HAp (100 μg mL<sup>-1</sup>) and (e) CD@HAp (200 μg mL<sup>-1</sup>). Scale bar represents 100 μm.

6.9.	Fluorescent microscopic images showing MG63 cells growing on	6-18		
	membranes after 7 days of culture: (a) MWPU, (b) WHPU/HAp1, (c)			
	WHPU/HAp3, (d) WHPU/CD@HAp1 and (e) WHPU3/CD@HAp.			
	Scale bar represents 100 μm.			
6.10.	Graph showing ALP activity of MG63 cells after 7 days: (a) with	6-20		
	different nanomaterials and (b) on different nanocomposite			
	membranes. Data represented as the average±standard deviation. (*			
	p < 0.05, ** p < 0.01).			
7.1	(a) FTIR spectrum of NiFe <sub>2</sub> O <sub>4</sub> @rGO, (b) XRD pattern of	7-10		
	NiFe <sub>2</sub> O <sub>4</sub> @rGO, <b>(c)</b> Raman spectra of GO and NiFe <sub>2</sub> O <sub>4</sub> @rGO and			
	(d) EDX spectrum of NiFe <sub>2</sub> O <sub>4</sub> @rGO.			
7.2.	(a) and (b) TEM images of NiFe <sub>2</sub> O <sub>4</sub> @rGO; (c) Size distribution	7-11		
	of NiFe <sub>2</sub> O <sub>4</sub> ; (d) Edge of rGO sheets; (e) and (f) HRTEM of			
	NiFe <sub>2</sub> O <sub>4</sub> phase; <b>(g)</b> SAED pattern of NiFe <sub>2</sub> O <sub>4</sub> @rGO; <b>(h)</b> IFFT			
	image of NiFe <sub>2</sub> O <sub>4</sub> phase; (i) FFT image of NiFe <sub>2</sub> O <sub>4</sub> phase (inset			
	FFT after masking).			
7.3.	Magnetic behavior of NiFe <sub>2</sub> O <sub>4</sub> @rGO under the magnetic field of	7-12		
	an ordinary magnet.			
<b>7.4.</b>	(a) and (b) TEM images of PNC2.0.	7-14		
7.5.	FTIR spectra of PNCs.	7-14		
7.6.	(a) TG thermograms of PNCs, (b) DSC curves (cooling) of PNCs	7-17		

showing  $T_g$  and **(c)** DSC curves (heating) of PNCs showing  $T_m$ .

Shape memory behavior of PNCs under microwave (300 W)

7-19

7.7.

irradiation.